*** **The Publishers avail themselves of permission to print the following letter from a gentleman whose authority is as unquestionable in Historical Literature as in the Educational World.**

81 LINDEN GARDENS, LONDON, W.,
*August 4th*, 1887.

MY DEAR SIR,—*When about thirteen years ago you informed me that you were going to publish a series of works on Commerce, its history and principles, I expressed to you my hearty good wishes for success in an undertaking for which I considered you pre-eminently qualified. The sentiments thus expressed allow me now to repeat. Since then, great changes have taken place—changes brought about in a great measure, I believe, by your own publications. The establishment of technical and industrial schools and colleges, which have recently been founded in all our great industrial centres, require now more than ever such guides as your books furnish. I therefore rejoice to learn that you are about to publish a new, improved, and enlarged edition of your great work. Teachers, no less than young men intended for commercial or industrial life, cannot but be very materially helped in their pursuits by the use of your books; and I sincerely trust that England may maintain that position in commerce and industry which seemed at one time to be threatened by our neglect of such scientific study.*

*With heartiest wishes for the success of this fresh issue of your works,*

*I remain, yours very sincerely,*

L. SCHMITZ, LL.D., F.R.S.E.,
*Late Rector of the Royal High School of Edinburgh, and Examiner in Classics in the University of London.*

*To* Dr. JOHN YEATS.

*On a few of the Difficulties that retard the progress of Higher Commercial Instruction, and prevent the study of Commerce as a Science in England, adapted from a letter to the* "Journal of the Society of Arts," *by* Dr. YEATS. London. July 1, 1887.

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I. *What chiefly prevents the wider study of Commerce in England?*
II. *Why is it promoted abroad as part of public School-instruction?*
III. *What can be learned of Commerce out of a Counting-house?*
IV. *Are Continental Trade-schools connected with the old Guilds or the Government?*
V. *Is there anything new or special in their preparation for business?*
VI. *Is Commerce rightly considered a science?*
VII. *What does the science of Commerce comprise?*
VIII. *Should it be systematically taught everywhere?*
IX. *Might not Industrial Universities interfere with business enterprise?*
X. *Are there any English Text-books for the study of Commerce?*

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INDIFFERENCE is the greatest difficulty; and misapprehension of our true position causes it. Many say: "*Why should commerce be generally or even widely studied, when it concerns the mercantile part of the community only?*"

The mercantile part is the larger and more important one, and the principles of exchange affect every member of the community. Agriculture will not suffice for a growing

population like ours; the best resource now is the deck of a merchantman, or a desk on 'Change.

Seven hundred individuals leave our country every day, literally to "seek their fortunes;" and how are they prepared for the task? Even after their departure, eleven hundred others, strangers, need providing for. Of the two great factors of wealth,—materials and intelligence,—*the latter only* can be multiplied and made common property; happily it is the more valuable. On this head Mr. Robert Mallet said after the International Exhibition of 1862:—"In the absence of the sovereign gifts of natural wealth,—prosperity, comfort and power may, by seeking and employing artificially-made channels of industry, be largely developed. Thus it was with the Dutch, once prayed for in English liturgies as 'the poor and distressed States of Holland,' with a bleak and damp climate, and a sterile soil presenting nothing but a flooded bed of sand and silt,—who achieved in the teeth of every disadvantage, the highest mercantile prosperity, a paramount maritime prowess, and became the founders of great and distant colonies."

INSULAR PREJUDICE prompts many others to say: "*Because our neighbours choose to go to school to learn business, need we do the same?*" *Why do they do it?*

In comparing ourselves with others, we must remember that a century ago, the introduction of steam-power gave to England a preponderating advantage. Our possession of beds of coal and of iron ore promised to secure that: but the rest of the world thought it desirable and possible to find in the more genial diffusion of mental power a countervailing agency to our increased material force. Continental philanthropists and patriots urged that "the mind of a nation is more valuable than its soil." Statesmen welcomed the idea with enthusiasm. Humboldt and kindred spirits were appointed ministers of public instruction. Chosen bands,—nay battalions, of teachers were enrolled,

and disciplined to do the state the noblest service. It was never supposed that the general ability and the good will of an operative could be multiplied or intensified like the leverage and the steam-power of an engine,—*the contrary was felt;* and a *science of education* arose, as a result of the study of the human being to be educated, no less than of the departments of human knowledge,—yet, out of that study came many divisions and subdivisions of instruction both in universities and in polytechnic institutions.

"*But what,*"—it is continued, "*can be learned of commerce in schools, or anywhere out of a counting-house?*"

The reply is clear. A counting-house is a place in which commercial knowledge must be used rather than sought. Abroad, a youth at school studies the sources of supply for the goods he must hereafter deal in. There he is made acquainted with the laws and conditions of soil and climate, and afterwards brought into contact with specimens of produce in Trade-Museums, from different Trade-Areas; these he is required to examine and describe methodically. He is habituated to scientific nomenclature,—which is suggestive not merely of the natural relationship among things, but of their chemical composition and valuable properties. He learns the "Natural" in contradistinction to the "National" Divisions of Commerce,—the resources of countries, rather than the names of their Ruling Powers. He studies the progress of the Useful Arts everywhere; the Growth and Vicissitudes of Commerce in all ages. From the outset, he is accustomed to a kind and degree of intellectual discipline that must beneficially affect him.

Inquiry is further made, "*Whether Continental Trade-schools are in any way connected with the old Guilds, or with the Government?*" Not necessarily with either! Influential merchants and manufacturers, foreseeing the effects of the dissolution of the Guilds, and of the adoption of

"free industry," with its irresponsible action among capitalists as well as its uncontrollable combinations among operatives, bethought them of higher culture as the best means of promoting a good understanding among all parties. "Let us establish," said they, "by the side of the universities, Polytechnic Schools and Technological Institutes. Let us, by means of Art Galleries, Drawing-Schools, Apprenticeship-Schools, Continuation-Schools, Trade-Schools, and Trade Museums, bring the means of living more into harmony with the great ends and aims of life. Let us train head, heart, and hand together. To the study of the Word let us add the Works of God."

No opposition was raised, and there was virtually no attempt made to retain the monopoly of the ancient Guilds, or to resuscitate a single League; yet the discipline that had marked them all, their love of excellence, and their allegiance were reverently preserved.* It was felt that in most departments of industry, except agriculture, "there was periodically a want of some renovating and regulating power."

Government aid was invoked only for inspection and approbation. Here and there Schools of Commerce were warmly encouraged by dispensations from military service in favour of exemplary students.†

Next, it has been asked, "*Whether there is any novelty or speciality in the Continental preparation for business?*"

Nothing, known to me! The canons of instruction in

* For details of the transition, see Zschokke's Labour stands on Golden Feet, caps. xix. and xx. G. Philip & Son.

For practical measures, see Das Gewerbewesen im Königreiche Bayern, diesseits des Rheins, München, 1859. Or, Ein gewerbliches Fragenbuch, by Dr. Karl Karmarsch, 1877.

See also Technical Training, by T. Twining, Twickenham.

Education, Scientific, and Technical, by Professor Robert Galloway. London: Trübner & Co.

† Rothschild's *Taschenbuch für Kaufleute*, p. 4.

Commerce, I incline to think, comprise something like the following, for ground-work :—

It has been observed that certain modes of procedure in business recur from generation to generation. These are the unwritten laws—the prescriptive usages of Trade,—to be learned, and understood.

In all transactions, mercantile or otherwise, there is a safe course and an unsafe one, a right course and a wrong one. It is important to adopt the former and avoid the latter.

Good fortune or the reverse cannot be a matter of indifference; but in business we must trust nothing to luck or chance.

For each legitimate calling there must be due preparation, and for permanence, organisation; to ensure excellence on the one hand, and to remedy the effects of illegitimate trading on the other.

Every calling in life relates to the mind or the body. Commerce is concerned chiefly with material necessities; and commercial men are rather men of action than theorists. All theories and speculations need practical tests. "As the downward curve of a rocket or the fall of spray in a fountain, is caused by gravitation, so all flights of fancy or mere surmises, must be subdued by what Bacon calls the wisdom of business."

Where that wisdom of business prevails, commercial pursuits are assuredly not soul-debasing, or injurious in any sense, to any body. There should be no conflict or contempt between merchants and men of learning: for in their highest development they approach each other, like the opposite sides of a pyramid, and culminate in the character of the Statesman, the Consul, or the President of a Chamber of Commerce.

I have very often been asked: "*Why is Commerce called a Science?*" *Why do the French write "les Sciences du Commerce"?*

*

Commerce is a compound word, from "commutatio mercium," meaning, "the *exchange* of merchandise,"—which must be all drawn from one of the three Kingdoms of Nature. It may be "raw produce," as drugs, gems, minerals, wild-fowl, fish, &c., or,—manufactured commodities. Exchange itself, is necessitated by the structure of the globe. "*Non omnis fert omnia tellus.*" It is a characteristic of humanity, and underlies civilisation: "Man alone balances, yet deepens our mutual dependence by the arts of exchange."

Science has been defined: Knowledge of natural laws derived from a knowledge of facts. Theologically expressed, science is simply Man's knowledge of God's ways; which are unalterable, yet mercifully discernible. Thus while we may smile at the expression "Science of Commerce," it nevertheless begins and ends in a study of Nature, and no competent judge doubts the soundness of principles so based. Nor, can any sane man see our supremacy in manufacture and trade challenged in all markets, and our goods as well as our aspirants for mercantile employment at home, beaten by Dutchmen and Germans, without admitting that there must be something of value in the kind of training that accomplishes such things.

*What does the "Science of Commerce" comprise in its entirety?*

It comprises an acquaintance with Commercial History and Geography; Social and Political Economy; Mercantile Occupations; Goods, in all varieties; Currencies, Weights and Measures; Bullion and Exchanges; Transit and Transport; Insurance and Securities of all sorts; Consular Duties; Chambers of Commerce, &c.

A good commercial man must be an adept in—Correspondence in several languages, General Commercial Law, Accounts, Usages in different countries, International Obligations and Means of Communication.

Why *should Commerce be systematically taught everywhere?*

Because without Commerce industry must be intermittent; crops would not be raised unless a market could be found for them; our farms and our plantations might all be abandoned. Again, of two spots equally favoured by Nature, if one be cultivated and the other not, which redounds most to the credit of human nature and to the glory of God? What else than culture can lead to the full appreciation of the "Earth-Gifts" of Divine Providence, and qualify us to appropriate them everywhere? How else is "the field to become a fruitful garden, and the wilderness to blossom as the rose"?

In 1878, I ventured to say:—"By higher commercial education I do not mean that which leads a youth to look merely for a higher rate of interest on capital, or of profit in business, but, *that which trains him to appreciate fully the objects, advantages, and pleasures of a commercial calling.* Such an education would fit him to compete with all comers; to be prepared to keep faith with everybody; to value justly whatever is valuable; but not to expect uniformity of weight, measure, custom, or opinion throughout the world."

The question has sometimes been asked, *Might not the training of an industrial "university" be prejudicial to business-energy and enterprise?*

I answer, No! it would promote both! Most likely it would rouse the latent ambition of a youth; it would go far to preserve that integrity of soul which scorns a mean action, which maintains credit intact all over the globe, which upholds international morality, law, and liberty. Further—extended and more elevated culture in commercial colleges would promote greater energy and enterprise. It would, as nothing else could, make young men acquainted with the different regions of the globe; it would show the prospects of trade, where industry is rising,

where falling, and why. By educating young men together it would raise them, as it were, from the level of solitary anglers to that of systematic fishermen ; it would lead them from dreaming of baits and hooks only, to the study of supply and demand together with all the sciences of commerce.

In manufacture we have advanced from simple tools to combinations of them in machinery ; and so in commerce, we have passed from the scope of individual aptitudes to the range of co-operative intelligence.

JOHN YEATS.

CHEPSTOW, *June*, 1887.

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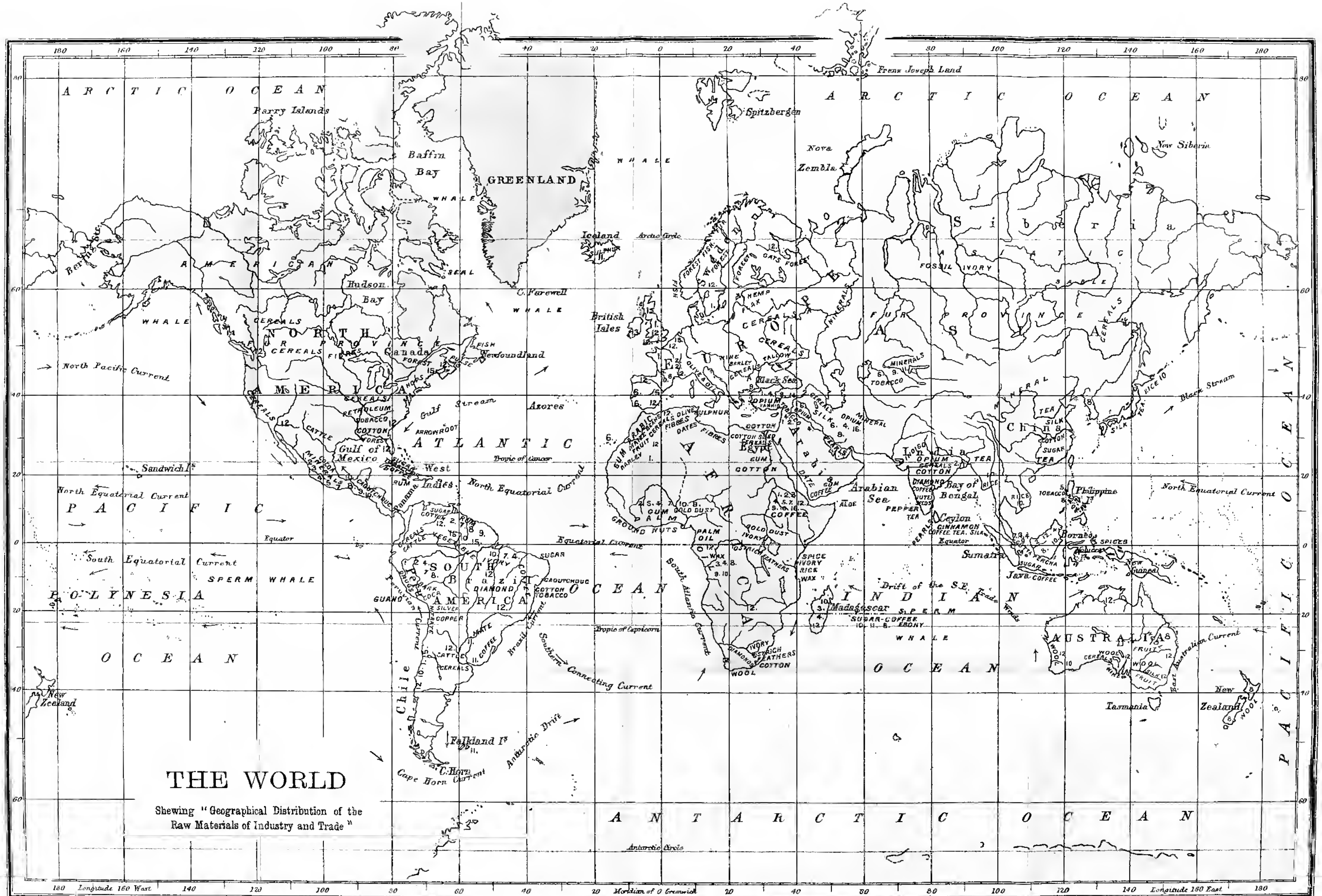
*P.S.*—In reply to query No. X., I shall be especially gratified if any of my works prove useful to the students who avail themselves of the Commercial Examinations of our Society, and thus promote the aims of our late President, the illustrious Prince Consort, as well as those of H.R.H. the Prince of Wales, his successor, and the founder of the Imperial Institute.

R. Phillips.
Pch: 1889.

THE NATURAL HISTORY

OF THE

RAW MATERIALS OF COMMERCE.




THE WORLD

Shewing "Geographical Distribution of the Raw Materials of Industry and Trade"

Explanation of Figures on Map.

1 Cereals (Wheat, Barley, Oats, Rye)
2 Cereals (Rice, Maize)
3 Coffee, &c.
4 Cotton
5 Sugar, &c.
6 Vine, Wine, &c.
7 Spice and Tropical Fruit
8 Fibres
9 Dye Stuffs and Woods
10 Forests and Products
11 Animals and Products
12 Minerals
13 Dairy Produce
14 Silk, &c.
15 Fruits, &c.
16 Drugs, &c.

PREPARED FOR DR. YEATS' MANUALS OF COMMERCE.



GEORGE PHILIP & SON, LONDON & LIVERPOOL

Technical, Industrial, and Trade Education.

THE

# NATURAL HISTORY

OF THE

# RAW MATERIALS OF COMMERCE.

*ILLUSTRATED BY SYNOPTICAL TABLES, AND A FOLIO CHART; A COPIOUS LIST OF COMMERCIAL PRODUCTS AND THEIR SYNONYMES IN THE PRINCIPAL EUROPEAN AND ORIENTAL LANGUAGES; A GLOSSARY AND AN INDEX;*

**With an Industrial Map printed in Colours.**

BY

JOHN YEATS, LL.D.,

FELLOW OF THE GEOLOGICAL AND THE STATISTICAL SOCIETIES, AND TWELVE YEARS EXAMINER IN COMMERCIAL GEOGRAPHY AND HISTORY TO THE SOCIETY OF ARTS, LONDON.

ASSISTED BY SEVERAL SCIENTIFIC GENTLEMEN.

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AND 45 TO 51 SOUTH CASTLE STREET.
1887.

TO

*THOMAS SPENCER SMITHSON*

*OF FACIT*,

NATURALIST;

IN WHOM SURVIVE MEMORIES AND HOPES

OF AN

"OLD HOUSE AND HOME WHERE THE FOREFATHERS DWELT,"

**This Volume**

IS AFFECTIONATELY INSCRIBED

BY

JOHN YEATS, LL.D., &c.

"Man can only act upon nature, and appropriate her forces to his use, by comprehending her laws, and knowing those forces in relative value and measure. Bacon has said that, in human societies, *knowledge is power*,—both must rise or sink together. Knowledge and thought are at once the delight and prerogative of man; and they are also a part of the wealth of nations, and often afford to them an abundant indemnification for the more sparing bestowal of natural riches. Those states which remain behind in general industrial activity, in the selection and preparation of natural substances, in the application of mechanics and chemistry, and where a due appreciation of such fails to pervade all classes, must see their prosperity diminish, and that the more rapidly, as neighbouring states are meanwhile advancing both in science and in the industrial arts, with, as it were, renewed and youthful vigour."—*Cosmos.*

# PREFACE.

THIS Natural History of the Raw Materials of Commerce treats of each substance wherever it originates, above ground or beneath the surface; shows what is done with it to make it useful; and indicates where it is bought, sold, or largely consumed. The simplest divisions of the subject have been adopted,—those of the Mineral, Vegetable, and Animal Kingdoms. All products are classified, and scientific terms are attached for wider reference.

Within so small a compass the choice of "raw materials" is inevitably restricted to the most useful, the most attractive, or those the treatment of which promises to be suggestive; but the Tables in the Appendix will be found to supplement the text, and perhaps be sufficient for educational purposes. The Manual is designed for youths who are preparing for business at home, or for emigrants and industrial pioneers.

To meet the requirements of the first, the United Kingdom is examined geologically and geographically, as a home-study. The advantages and disadvantages of our insular position, our variable climate, varieties of soil, of level, of navigable stream and indented coast, with abounding fisheries, are dwelt upon, briefly

but plainly. Of Greater Britain and the rest of the world, as much is added as can be comprised within a few chapters. The migrations of plants and animals are not wholly overlooked, in connection with colonial enterprise and the shifting of trade-centres. It will be good training for a student to search out for himself why madder, saffron, and woad, once common in Germany, are now seldom seen there; why the sugar-cane has gone from southern Spain and Italy, and why the olive or even the vine is less extensively cultivated in Italy and France than formerly. He may ask too why wool, hides and meat, come so largely from the cattle-ranches and sheep-runs of the colonies, instead of from our own pastures; and he may be astonished to hear that very few years ago, Australia had no other animals scarcely than "hogs and dogs,"—and little or no agricultural or garden produce,—while to-day it is rich in horned cattle, horses, sheep, goats, geese, rabbits and fowls. It has fish of many kinds; and grows potatoes, tobacco, wheat, maize, vegetables, and the finest fruits. There too the honey-bee swarms, and the silk-worm thrives.

The knowledge of raw materials is too much confined to specialists—to brokers and middlemen. Nowhere perhaps is the study more neglected than in England, and to this cause may be ascribed the complaints of a want of "new industries." Should not this rather be called want of new enterprise? I will not dilate on the topic, but to encourage the young, append here statements made by me elsewhere long ago. They may give some clue to the real uses of my little book, and lead to readier apprehension of the aims embodied in it.

It is curious that the materials entering into commerce so extensively now, were almost unknown to the wealthy Greeks and Romans. Beer, butter, coffee, cotton, fish-oils, potatoes, spirits, sugar, tea, and tobacco, are all modern. Of those which constitute the staples of our activity, the majority have been introduced into the market within comparatively few years, and many of them seem to have become known and appreciated from purely accidental circumstances. For instance, in 1842, an English surgeon, Dr. Montgomery, while walking in the outskirts of Singapore, noticed that the handle of a woodcutter's axe was something peculiar. He examined it, learned where the material was procurable, and soon sent over to England *gutta-percha*, without which we could not have laid our submarine electric cables.

About the same time, a chemist in Calcutta received from the interior of India some wide-mouthed vessels enveloped in a fibrous substance which attracted his attention and that of a rope-maker. It was *jute*,—since largely grown in Bengal,—and the manufacture of which has now become the staple industry of Dundee and other towns of the North.

It was in cutting the channel for a watermill in California, in 1848, that a quick eye detected in a quartzose rock grains of *gold*, the beginning of a discovery that afterwards revolutionised labour and the markets.

In 1850, an engineer in the same country was struck, while at church, with the very beautiful red colour used in the decorations of the interior. He inquired whence it came, and was told that it was an earthy powder brought by the Indians of the moun-

tains to their *padre*, a missionary. He investigated the source, and found cinnabar the bisulphide of mercury. The working of the mines of New Almaden was the consequence, and soon after, a fall in the price of *quicksilver* in Europe and America.

During the opening out of a Pennsylvanian salt-spring in 1859, the diggers struck a deposit of *petroleum*, which afterwards gave a name to the locality, Oil Creek,—and an important article of commerce to the world.

In 1860, a shepherd in the employ of Mr. Hughes, of Wallaroo, South Australia, noticed that a *wombat*, an animal about the size of a badger, had while enlarging its den thrown up to the surface of the ground small pieces of greenish stone. These he collected, and carried to his master, who recognised in them an ore of *copper*. The place was examined, a fine vein of that metal laid bare, and soon the mines of Wallaroo were added to the celebrated ones of Kapunda, found in 1844, and of Burra Burra, found in 1845.

More recently still, at the beginning of 1867, a farmer of Pniel, in the republic of the Transvaal, South Africa, passing a neighbour's door, noticed a stone in the hand of a child, and asked the mother if she would sell it. "Sell a pebble!" said she, "No; but you are welcome to have it, if you care to take it!" The farmer carried it to Capetown, and showed it to Dr. Anderson, who declared it to be a *diamond*. It was immediately sent to the Paris Exhibition, and was there valued at 12,500 francs, about £500. A tract of territory, hundreds of miles square, was quickly explored, more precious stones were extracted, and the land thereby raised in value enormously.

Sir Titus Salt, about 1836, observed the first sample of *alpaca wool* in a corner of one of the warehouses belonging to the Liverpool Dock Company, where it had been lying neglected for a long time, as of no marketable value.

In a lecture delivered at the City of London College so lately as 1861, Mr. P. L. Simmonds said: "It was not till the year 1800 that any considerable quantity of cotton was received from the United States. Mr. Samuel Maverick of Pendleton, South Carolina, who assisted in packing the first bag of uncleaned cotton ever sent from America to Liverpool, is still living! The consignee of this lone bag informed the shippers, Messrs. Wadsworth and Turpin of Charlestown, that 'he could not sell it,' and advised them to 'send no more.'" He little foresaw what Eli Whatney, Watt, and Arkwright would do with it ultimately! With one more instance I close.

To protect the hull of his vessel from the rough walls of a quay in a Brazilian port, the captain had caused a sort of round fender to be made of weeds that grew on the river banks. The same fender was used for a similar purpose on his arrival in the docks of the Mersey, and at length left on the shore. A brushmaker looked at it and begged it, worked it up, and soon wanted more of it; it was the *piassaba* for coarse stable and street-sweeping brooms.

Now, how far the world has been benefited by the work done through the agency of these really competent observers, and to what extent they or the bystanders became ultimately enriched, need not here be inquired. Of far greater significance to us is the plain recognition of a fact too often overlooked, that

"light is not vision;" that "the eye sees only what it brings the power to see."

On the other hand, we are sure from all testimony and experience, that "knowledge is power."* And we may feel safe in supposing that every one of the skilled men concerned in these discoveries was an educated man, trained beforehand in some if not several of the following sciences of observation:—

GEOLOGY.—Treating of Modes of Occurrence of Metallic Ores, Mineral, Fuel, and Building Materials; Agricultural Soils.

MINERALOGY.—Constituents of Mineral Substances, Metals, Earths, &c.

GEOGRAPHY.—Distribution of Animals and Vegetables; Climate, as Determining the Introduction of Useful Plants and Animals.

ECONOMIC BOTANY.—Food and Textile Products; Timber and Fuel; Oils, Gums, and Resins.

ECONOMIC ZOOLOGY.—Food and Textile Products; Furs and Leather; Bone and Ivory; Oils.

These form part of "The Sciences of Commerce," and as such, are the subjects dealt with in this book. J. Y.

CHEPSTOW.

* "Man can only act upon nature, and appropriate her forces to his use, by comprehending her laws, and knowing those forces in relative value and measure. Bacon has said that, in human societies, *knowledge is power*,—both must rise or sink together. Knowledge and thought are at once the delight and the prerogative of man; and they are also a part of the wealth of nations, and often afford to them an abundant indemnification for the more sparing bestowal of natural riches. Those states which remain behind in general industrial activity, in the selection and preparation of natural substances, in the application of mechanics and chemistry, and where a due appreciation of such fails to pervade all classes, must see their prosperity diminish, and that the more rapidly, as neighbouring states are meanwhile advancing both in science and in the industrial arts, with, as it were, renewed and youthful vigour."—*Cosmos.*

K. Phillips.
Oct. 87—

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# THE NATURAL HISTORY

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## CHAPTER I.

### RAW MATERIAL.

Meaning of the term Raw Produce—Necessity of a Knowledge of Raw Materials—Original Discovery of Raw Materials, and Effects of Discovery—How a Knowledge of Raw Materials can be gained —The Study of the Raw Materials of Industry must begin at home —Essential aid of Museums.

IN the earth, with its oceans of water and of air, we find those natural resources from which, chiefly, we draw the means of material support. The produce of its teeming waters, the animals and plants upon its surface, furnish us with food and clothing; the stone, the metals, and the coals laid up in its crust, supply us with the means of shelter, with various implements, and with fuel. Several facts connected herewith are part of our earliest experience. 1st. There is in the world an indefinitely large number of substances adapted to our service in health and in sickness. 2nd. These substances are distributed so that each region has its special treasures. 3rd. The inhabitants of any one region may, by exchange, become possessed of the abundance and variety of all other regions. If, for example, the Norwegian has plenty of timber, but a scarcity of wool, and thus finds himself well housed, but poorly clad, while the English-

man has woollen cloth to spare, but wants timber for building, each may, by interchange, be well clothed and well housed.

In speaking of the natural resources of any country, we refer to the ore in the mine, the stone unquarried, the timber unfelled, the native plants and animals—to all those latent elements of wealth only awaiting the labour of man to become of use and value. To the expression *Raw produce*, however, an extended meaning is assigned. We do not merely gather in the indigenous materials of the country where we live, but, by intelligent industry, we increase the natural production. Tillage and cattle-rearing procure for us a greater abundance of corn and fruit, and flesh-food, and textile fibres than we should otherwise enjoy. This increase, and all the crude constituents of wealth, whatever their origin, come under the designation of *raw produce*, or, in commercial language, of *raw materials*.

Without a considerable knowledge of raw materials, and of their adaptations, we could not live; and without an unremitting application of such knowledge we could not live in comfort. We may even measure a country's civilisation by the extent and diffusion of this important knowledge. Barbarous tribes pass their time in providing for their recurring appetites, and cannot be said to enjoy existence, in the sense of mental enjoyment. Where such tribes do not die out, their numbers, at the best, remain stationary. Among civilised nations, knowledge is increased; and many things, which in some parts still remain to be discovered, have in other parts become the necessaries of life for populations doubling and trebling in a century.

The economic history of a nation would be a record of the discovery of new raw materials, of new sources of supply,

and of additional applications. All such discoveries tend to our benefit, while their result is occasionally to enrich the discoverer, and to change the face of our social and industrial life. It has been said that he who makes two blades of grass grow where only one grew before is a benefactor to his species. The truth of this statement is easily proved. Take the single example of wheat, and imagine the blessings which a double produce of this grain alone would confer upon mankind.

The manifold uses of coal afford remarkable instances of the effects of discovery. Though Corinth produced what we might call Birmingham and Sheffield wares, and Athens was the centre of such manufactures as we now find divided between Leeds, Staffordshire, and London, yet coal was not employed by the Greeks and Romans; it was not used as fuel, even at Newcastle, till the thirteenth century, and it crept into general use only during the reign of Elizabeth. This one material has been the main cause of a complete revolution in our national industry. It is but a generation or two since, by means of coal, a new motive-power, steam, was evoked, and native wrought-iron was first extensively applied to mining, to machinery, and to locomotion. Now every civilised country is scored with railroads, cities are lighted with gas, and coal and iron have, too, changed the character of our ships and our mariners. Before coal was used to generate steam, the sites of manufacturing towns were determined chiefly by the convenience of mill-streams, and the woods were the seats of smelting. The forest fires are now extinguished; the fabrication of iron has travelled to the coal-fields, which have become the most densely-peopled parts of the kingdom, and the scenes of the busiest industry. Wool, once the staple industry of England, is now second in magnitude and importance as compared with cotton; yet, with the

discovery of new sources of supply, and with increased home production, the quantity made into clothing is vastly greater than in former times. On the Continent, the introduction of the silkworm, more than a thousand years ago, gave rise to the unrivalled manufactures of the South of France, and originated one of the chief elements of the wealth of Italy and Greece. The dyeing of textile fabrics leads us into the domain of chemistry, a subject requiring a volume merely to name its discoveries. Indigo has displaced woad as a blue dye; and the new aniline colours, outvying the Tyrian purple, elevate our taste and gratify our sense of beauty. If we take other examples, similar facts appear. The Chilian potato has provided food for many millions of people, and in three hundred years has reached in Europe a perfection to which in its native soil it never approached. Maize has become an important crop round the Mediterranean; while wheat, which was given to America in exchange, has flourished there so greatly as to admit of large exports to the Old World.

Discoveries of the utmost value appear, for a time, of less significance, because their full development is not at first realised or foreseen. It is not easy for us to determine how far the industrial and social habits of posterity may be influenced by the production of the hydrocarbons and mineral oils. From the first employment of caoutchouc for rubbing out pencil-marks, its applications have been manifold. In guttapercha we see applications of a new raw material to telegraphy, embracing the world. We have only to contrast the present period of our history with any former period, or the condition of any one country with another, to perceive the effect of such knowledge upon human well-being. Every year adds to our list of useful animal, vegetable, and mineral substances; while the increasing consumption of those already known calls forth, as a rule, increased

production. Thus, the importance of a knowledge of raw materials cannot be overrated. It is a matter of personal interest to everybody in every part of the world. It must not be forgotten, however, that no amount of abstract reasoning would have led us to discover the properties and uses of iron, without first seeing, handling, and examining a piece of that metal. Experiment precedes the growth of knowledge. Every discovery of a new material, or a new property of an old material, has suggested new uses; and fresh necessities have led continually to fresh researches. Dyeing, tanning, brewing, glass-making, and weaving were known to the Egyptians in very ancient times, ranging from 1500 to 2500 years before Christ. These industrial operations involved a prior discovery of the raw substances operated upon. Indigo and purple dyes, bark and other astringents that effect the change of skin into leather, barley and malt, silicious sands and alkalies that, admixed, form glass—silk, linen, and cotton woven in primitive ages—must all have made part of the earliest human history; and passing over a long interval, we read of quills being used for writing (A.D. 600), of the use of sugar among the Arabs (A.D. 850), of coffee among the Persians (A.D. 875), &c. &c.

Without extending the list, we may dwell upon the thought of how much we owe to the past, even in these few selected instances. The same methods that rewarded our ancestors with fruits of discovery must be still followed if we desire the like rewards. Our forefathers observed, compared, tested, and applied, age by age, the gifts of nature, and bequeathed to us the accumulated stores of their experience. To come into possession of a complete knowledge of economic substances, our inquiries must begin early, and at home. Here the articles are at hand, and we are accustomed to the use of them; though with

imports from all parts of the earth, it has become difficult to say whether we are most interested in our own, or in foreign produce. In England, the facilities for study surpass those of other nations, and we may reverse the usual steps of inquiry, and endeavour, from the raw substance itself, to arrive at the conditions of its being, as well as its essential characteristics. What we know of the undeviating laws of nature opens our minds to inferences and generalisations whenever a basis of facts is broad enough to support a correct induction.

In the vegetable kingdom, we see the distinction between *endogens* and *exogens* clearly marked from the cotyledons through the whole life-history of the plants. The structure of the stem, the veining of the leaves, the number and character of the floral organs, all differ persistently in the great sub-kingdoms. A worker in wood will tell, from the texture and grain, not merely the species but the variety of tree, and the place of its growth. A mahogany merchant will distinguish the timber of Cuba from that of other West Indian territory, and island growths from those of the mainland. Again, the starches existing in so many plants are distinguished from one another by the form of their grains, so that potato-starch mixed with arrowroot can be easily detected; and flour of every kind indicates in the same way the grain from which it was prepared. The microscope shows an identity of structure between the nutmeg or hard kernel, and the arillus or mace, that enwraps it, and would prove that the two substances belong to each other, greatly as they differ in appearance, even though their relationship were not otherwise known. In a general way, if we see a rattan, bamboo, or palm stem, we at once know it to be an exotic, or tropical production; and we infer, from the ferns and calamites of the Coal Measures, that the beds of shale and coal originated under

conditions of climate quite different from those now prevailing in the temperate and frozen regions, where such beds are found.

Examples abound equally in the animal kingdom. We do not hesitate to draw climatic inferences from the presence of the bones of certain fossil carnivora in cold regions, although such inferences receive no support from the existing climate. With living animals we can usually trace their geographical relation, and say, *this* is a tropical bird, fish, or insect; *that* belongs to the frigid zone.

The more minute our investigations, the more is this law of the individuality of every natural product, and of the mutual adaptation of all the conditions of existence, confirmed. The structure of a bone enables naturalists to build up the animal of which it is a part, to describe its habits, and to fix its proper position in the vertebrate series. Professor Owen has demonstrated that the dental or tooth structure of every species of animal is distinct, and that, were our knowledge comprehensive enough, it would unerringly guide us to the identification of the animal.

From these illustrations, it will be seen that all raw substances contain within them structural evidences of the conditions under which they were developed; and that by a scientific induction, possible only with increased knowledge, we may learn to read these evidences, and to apply our knowledge to the improvement of the substance—that is, to its increased utility. Books will not only show the knowledge already acquired, but they will direct the student in his search for more. The history of discovery shows how advances have been anticipated, how new powers or properties were generally suspected, and how they revealed themselves in answer to scientific interrogation. Herein we perceive the utility of museums, where economic substances from the three kingdoms of nature are classified for comparison and

study. In every civilised country there are museums; and every school should also be a repository of specimens of raw produce, in the nature and use of which direct instruction should be given. Early familiarity with the substances themselves would lay the foundation of knowledge, which would not only save the young man of business the first weary years of learning, but would send him forth into the domain of nature, perhaps as a discoverer of new materials, or of new properties or adaptations, adding to the necessaries and conveniences of life, and therefore to the health and happiness of mankind.

## CHAPTER II.

### OUR NATIONAL HOME.

Climate, Soil, and the Consequences resulting therefrom—Latitude of the United Kingdom and Contrast of Corresponding Latitudes—Position of the United Kingdom relative to Europe—Diversities of Temperature and of Rainfall—Causes of Diversity—Gulf Stream—Deflection of Isotherms—Current and Counter-Current—Aerial Currents—Botanical or Floral Regions—Iberian or Asturian, Armorican, Germanic, and Boreal Regions—Minor Diversities of Climate and Vegetation—Chart of Floral Regions.

**The United Kingdom,** between 50° and 60° N. lat., by 2° E. and 11° W. long., comprises several islands, of which Great Britain and Ireland are the chief, the remainder being relatively unimportant.

**Great Britain,** including England, Wales, and Scotland, is the largest island in Europe.

**The British Empire** comprehends, besides the United Kingdom, colonies and possessions in every zone, so extensively and widely dispersed as to give literal truth to the saying that the sun never sets on the Queen's dominions.

The latitude of the United Kingdom corresponds with that of the cold and sterile regions of Labrador, in America, and the icebound shores of Kamtschatka, in Asia. In the southern hemisphere its like or analogue is the cheerless land of Terra del Fuego. London is in the same latitude as the strait of Belleisle and Cape Lopatka; Edinburgh, the northern metropolis, corresponds with Moscow, and also with Cape Horn.

These are striking contrasts. We cannot imagine a flourishing people living in the bleak and pitiless countries just referred to. From what, then, are our immunities derived? A well-known American writer says of England:—

"The territory has a singular perfection. The climate is warmer by many degrees than it is entitled to by latitude. Neither hot nor cold, there is no hour in the whole year when one cannot work. The temperature makes no exhaustive demands on human strength, but allows the attainment of the largest stature. In variety of surface it is a miniature of Europe, having plain, forest, marsh, river, seashore; mines in Cornwall, caves in Derbyshire, delicious landscape in Dovedale, and sea-view at Torbay; highlands in Scotland, Snowdon in Wales; in Westmoreland and Cumberland a pocket Switzerland, in which the lakes and mountains are on a sufficient scale to fill the eye and to touch the imagination.

"From first to last it is a museum of anomalies. This foggy and rainy country furnishes the world with astronomical observations. Its short rivers do not afford water-power, but the land shakes under the thunder of its mills. There is no gold mine of any importance, but there is more gold in England than in all other countries. It is too far north for the culture of the vine, but the wines of all countries are in its docks; and oranges and pine-apples are as cheap in London as in the Mediterranean." *

## *RELATIVE POSITION OF THE UNITED KINGDOM.*

Great Britain is insulated from the Continent by the arms of that ocean which forms the western boundary of Europe. For about a hundred miles west of Ireland the slope of the sea-bed is gradual, when a sudden descent occurs of more than 2000 feet, forming submarine cliffs that mark the confines of the Old World. The bed of the German Ocean, on the other hand, is generally shallow. Its average depth is not over thirty or forty fathoms, which would not cover the chimney-shafts of many of our factories,

* "English Traits." By R. W. Emerson.

and in no part are the soundings deep, except off the precipitous coasts of Norway, which the Atlantic, rather than the North Sea, may be said to lave. Traversing this sea are also many shoals and sand-banks, the largest being the Dogger, 350 miles long, running northward, midway between the coast of Northumberland and Jutland. Some of these banks come within six or seven fathoms of the surface.

The neighbouring lands on both sides of the German Ocean assume the features of the sea-bed. Parts of Holland are forty feet below the sea-level, and are only protected from marine irruptions by embankments and sand dunes. Jutland is entirely alluvial. "English Holland," or the Fen districts in the neighbourhood of the Wash, consists of land reclaimed from the sea, much of it so low lying as also to require dykes and embankments to prevent inundation. In fact, the great European plain commences in the tertiary and alluvial deposits of the East of England, takes in the German Ocean, embraces the Netherlands and Denmark, then sweeps along the low lands and stoneless steppes below St. Petersburg, and extends to the Caspian Sea. The whole plain gives evidence of an ancient sea-bed, of which the sandy flats about Calais and Berlin, and the lake-plain of Pomerania, are parts, and with which England is conjoined. The United Kingdom consequently retains, in many respects, a European, although insular, character.

## *CLIMATE OF THE UNITED KINGDOM.*

"Climate," says Professor Ansted, "is a resultant of all the atmospheric phenomena, embracing the temperature of the air at various times and seasons, the range and variation of the temperature, the direction and force of the prevalent winds, the liability to storm, the amount of humidity in the air at various seasons, the quantity of mist

and rain, the distribution of rain, and the varieties of electrical condition."

"These phenomena affect and depend on each other, but all may ultimately be traced to certain general causes.

"1. The position of the station in latitude.

"2. The size and figure of the land on which the station is situated, whether detached island, archipelago, or continent.

"3. The elevation of the station above the sea.

"4. The position of the land on which the station is placed, with reference to the neighbouring land.

"5. The position, distance, and direction, magnitude and elevation, of the nearest continent.

"6. The nature, magnitude, and direction of the nearest great marine current to its shores."

The phenomena of the climate of the United Kingdom may be summarised under the heads of Diversities of Temperature and Diversities of Rainfall.

**I. Diversities of Temperature.**

The western coast of Ireland is 10° warmer than the east coast of England on the same parallel of latitude. Scotland, compared with England, is cold and wet, although not subject to extremes. The winters, indeed, are so mild that the harbours generally do not freeze, as in similar and even in lower latitudes on the Continent. The Western Islands have a uniform and genial climate, contrasting with the opposite coast. Unst, one of the Shetlands, and the Isle of Wight, correspond in winter temperature, although separated by nearly 700 miles, or 10° of latitude.

Again, Devonshire and Cornwall, in point of winter temperature, are warmer than London by 5°; Penzance and Torquay, in mildness and salubrity, resemble Madeira, and are recommended to patients affected with pulmonary disease.

The diversities of temperature are tabulated in the following chart:—

*Great Britain, East Side.*

| Locality. | Latitude. | Winter Temperature. | Summer Temperature. | Mean Temperature. |
|---|---|---|---|---|
| | | Fahrenheit. | | |
| Unst . . . . . | 60° 45′ N. | 38.6° | 52.6° | 44.7° |
| Wick . . . | 58 29 | 38.8 | 55.3 | 48.9 |
| Inverness . . | 57 28 | 35.0 | 57.0 | 47.7 |
| Aberdeen . . | 57 8 | 39.0 | 59.5 | 49.2 |
| Dundee . . . . | 56 27 | 41.4 | 63.4 | 51.9 |
| Leith . . . | 55 59 | 40.5 | 58.2 | 48.3 |
| York . . . | 53 57 | 36.2 | 62.3 | 49.2 |
| Bedford . . . | 52 8 | 40.5 | 62.8 | 51.6 |
| London . . . | 51 30 | 39.5 | 62.9 | 50.8 |
| Chichester . . | 50 5 | 38.8 | 60.7 | 49.5 |

*Great Britain, West Side.*

| Locality. | Latitude. | Winter Temperature. | Summer Temperature. | Mean Temperature. |
|---|---|---|---|---|
| | | Fahrenheit. | | |
| Glasgow . . | 55° 51′ N. | 39.6° | 60.1° | 49.8° |
| Whitehaven . | 54 33 | 39.9 | 59.6 | 49.0 |
| Isle of Man . | 54 15 | 41.7 | 59.1 | 49.8 |
| Liverpool . . | 53 24 | 41.3 | 61.1 | 50.8 |
| Swansea . . | 51 36 | 45.5 | 60.6 | 53.7 |
| Penzance . . | 50 7 | 44.2 | 60.9 | 51.7 |

*Ireland.*

| Locality. | Latitude. | Winter Temperature. | Summer Temperature. | Mean Temperature. |
|---|---|---|---|---|
| | | Fahrenheit. | | |
| Belfast . . . | 54° 36′ N. | 41.4° | 63.9° | 52.3° |
| Antrim . . . | 54 43 | 36.7 | 58.1 | 47.7 |
| Dublin . . . | 53 21 | 39.8 | 59.6 | 49.7 |

| Mean Temperature of the whole Coast. | Winter. | Summer. | General Mean. |
|---|---|---|---|
| West Coast of Great Britain | 40.3° Fahr. | 59.0° | 49.0° |
| East Coast of Great Britain . | 38.2 | 59.0 | |

Mean Temperature of hottest month (July), 60.0° to 65.0°.
Mean Temperature of sea on West Coast in winter is 41.0°.

### II. Diversities of Rainfall.

Constant humidity, rather than excess of rainfall, distinguishes the United Kingdom; for the total rainfall is

not actually greater than that of many other countries on the same latitude. Nevertheless, we owe to it our numerous rivers, and the fertility which makes nearly the whole land resemble a garden. Ireland is more humid than England, and the western side of both islands is more humid than the eastern. As a consequence, Ireland is essentially a grazing country, and in England pasturage is more common in the western than in the eastern counties, where tillage chiefly prevails. These facts are patent in the familiar terms of Irish butter, Devonshire cream, Cheshire and Gloucestershire cheese, Durham shorthorns, Alderney cows; while Norfolk and Suffolk and the valley of the Thames are suggestive of corn.

At Keswick, Cumberland, the yearly average rainfall is 60 inches; in London, the average is 24 inches. The average for the whole of the United Kingdom may be between 30 and 40 inches. The following diagram will give a concise view of the rainfall.

DIAGRAM OF THE RAINFALL OF THE UNITED KINGDOM.

*Ireland.*

| EAST SIDE. | | | WEST SIDE. | | |
|---|---|---|---|---|---|
| Londonderry . . . | 31.0 | inches. | Westport, Mayo . | 46.0 | inches |
| Belfast . . . . . . | 35.0 | ,, | Cahirciveen . . . | 59.0 | ,, |
| Dublin . . . . . . | 30.8 | ,, | Cork County . . | 40.0 | ,, |
| Portarlington . . | 23.0 | ,, | Castletownsend . . | 42.0 | ,, |
| Mean of Coast and Interior . . . | 29.7 | ,, | Mean of West Coast and Interior . | 47.4 | ,, |

*Great Britain.*

| EAST SIDE. *Coast and Interior.* | | | WEST SIDE. *Coast and Interior.* | | |
|---|---|---|---|---|---|
| Inverness . . . . | 27.0 | inches. | Cape Wrath . . . | 38.6 | inches. |
| Edinburgh . . . | 25.0 | ,, | Rothesay . . . . | 48.0 | ,, |
| W. Denton, Northumberland . . | 36.8 | ,, | Glasgow . . . . | 33.6 | ,, |
| York . . . . . . | 24.0 | ,, | Lake Districts from | 50.0 to 140.6 | ,, |
| Bedford . . . . | 31.7 | ,, | Liverpool . . . . | 34.7 | ,, |
| London . . . . | 24.0 | ,, | Swansea . . . . | 35.4 | ,, |
| Hastings . . . . | 31.0 | ,, | Penzance . . . . | 43.0 | ,, |
| Isle of Wight . . | 30.9 | ,, | Bath . . . . . . | 32.0 | ,, |
| Mean of East Side, &c. . . . . | 27.4 | ,, | Mean of West Side, &c. . . . . | 45.5 | ,, |

### III. Causes of Diversity.

Our western shores are bathed by an ever-flowing warm current from the Atlantic, called the Gulf Stream. The winds, for more than two hundred days in the year, blow in the track of this great marine current, and fill the air with balmy vapours exhaled from its surface. The Gulf Stream originates in the embayed waters of Mexico, whence, heated and expanded by a tropical sun, it issues as an ocean river through the Narrows of Florida. Widening in its course northwards, it divides in mid-Atlantic. One current curves to the north-west coast of Africa, and becomes lost in the equatorial waters. A polar prolongation, accurately defined, diverges till it fills the space between Iceland and Norway. By its influence the North Cape is freed from ice even in the depth of winter, and its effects are felt as far as Spitzbergen, where its interfusion with the surrounding ocean becomes complete.

The United Kingdom fully receives the beneficial influences of this stream. The warm air and heated flood combine to deflect northward the isothermal lines,* raising the temperature, and giving to high European latitudes the amenities of a southern climate. Now, it is a physical law that every current, whether aerial or marine, has a corresponding counter-current. We find, therefore, firstly, that at an undefined distance to the west, a cold stream flows down Baffin's Bay, and past the Greenland shores, sinking by its density beneath the Gulf Stream, and completing its circuit; secondly, that to the east a polar counter-current blows over the distant Russian plains to complete the aerial circuit. Thus we are twice favoured: by the presence of genial currents, aerial and marine, and by the absence of

* Lines laid down on maps to connect places which have the same *mean* temperature, or which are on parallels of equal seasonal temperature. (*Isos*, equal; *thermos*, heat, Gr.)

the arctic, inclement counter-currents, which respectively determine the climate of their neighbourhood. While the western maritime borders of Europe are verdant, the coasts of Labrador are frost-bound and barren; and the region of the intensest cold on the globe is in the Russian dominions.

At the time of the vernal and autumnal equinoxes the aerial streams in the latitude of the United Kingdom come into conflict; the cold easterly and north-easterly winds condense the vapours from the ocean, and produce characteristic fogs. These winds are trying to the health and life of both animals and plants, and often prevail for weeks together.

### *BOTANICAL OR FLORAL REGIONS.*

Within the confines of the United Kingdom various botanical or floral regions have been defined with tolerable accuracy, each region being characterised by its own climate, and called by a Latinised name.

Our cloudy sky keeps off heat, prevents radiation, and is favourable to the growth of crops whose variety makes up for the greater certainty of the harvests of the Continent. Though we do not enjoy uninterrupted fine weather, there is scarcely a day, except at the equinoxes, when the sun does not shine; and we rarely suffer from a succession of bad seasons.

In the part principally open to the Gulf Stream and to the prevalent winds, the air is so charged with moisture, that the sun's warmth is absorbed before reaching the earth, and fruits that will ripen farther north here seldom come to perfection. The peach tribe lose flavour, and grapes never reach maturity. The crops suffer less from drought than from too much wet. Botanists designate it as our *Asturian or Iberian Region*, from its relation to the Asturias, the

Biscayan province of Spain. The arbutus, London pride, three heaths, maiden-hair fern, and about seven other species of plants not occurring in any other part of Great Britain, are found in this botanical region. The provinces of Munster and Connaught in Ireland, and the county of Cornwall, with the adjacent parts of Devonshire in England, represent this region. Myrtles are fragrant in the open air throughout the winter. The evergreen oak, and the arbutus, are prominent in the overhanging woods of Killarney, where they were planted by the monks of Mucross. A rich neighbouring strip of land running through the two counties of Tipperary and Kilkenny, has for centuries borne the proud name of the Golden Vale, and produces, every season, abundant crops.

The south-west of England, adjoining Devon and Cornwall, agrees in climate with the French provinces of Normandy and Brittany, the flora of which is not prevalent elsewhere in the United Kingdom. Devonshire cider and Worcestershire perry indicate the English home of the apple and pear. "Normandy pippins" is an equally familiar term. Across the Channel the rural homesteads, the pastures, and orchards continue the aspect of England; while the oak, ash, and elm lend effect to the picture. Brittany, trending into the Atlantic, is even like Ireland in humidity and warmth. This district of France, the ancient Armorica, gives a designation to the English botanical region.

The vegetation of the midland and eastern parts of the United Kingdom, overlapping likewise every other floral division, bears a close relation to that of Central Europe, and comprises the most important and numerous plants. It is the region of deciduous trees, or such as lose their leaves annually, and includes our chief varieties of timber, with an undergrowth of wild apple, cherry, holly, hawthorn, broom, furze, wild rose, bramble, and honeysuckle. Food-

crops, both of corn and roots, here reach their highest perfection, and every kind of pulse and green vegetables, such as peas, beans, the turnip, carrot, potato, and cabbage, grow in abundance.

Farther north, the Scottish Highlands approximate in character to Scandinavia, the features being partially shared by the hills of Cumberland and Westmoreland. Vegetation greatly differs from that of the plains, and is analogous to the dwarf progeny of the snow-clad Alps, or of Arctic lands. Hence its botanical name, the *Boreal or Scandinavian Region.* The favoured parts of Sweden, and even of Lapland, are so nearly alike in soil and climate to Great Britain, that three-fourths of their vegetation are common to this country. While, however, our islands are nearly bereft of forests, and even England has yielded much of its forest land to the exigencies of husbandry, Sweden is covered with trees, and Lapland's woods are the chief source of its wealth. On the other hand, the summer scene presented by the wide-stretching archipelago upon which Stockholm is founded might be transferred to the balmiest part of the English coast; for the larks of those islets fill the air with song, and the ground is matted with wild strawberries, interstrewn with bright pinks and dog-daisies, while wild thyme, meadow-sweet, and other fragrant plants scent the air.

The prevalence of plants in groups has enabled us not only to define botanical districts or floral regions, but also to distinguish climate within short distances. If every condition were easily traced, the climate of any spot could be at once inferred; but our own country exemplifies the difficulties of accounting for the differences of climate in small areas. Brighton differs essentially from Torquay; Bath from Cheltenham; the climates of Malvern, Buxton, and Harrogate are unlike those of Scarborough and the Lake districts; and each in turn differs from all the rest.

It would be a good mental exercise to trace the local or the distant cause of these diversities.

In some instances the local variations of climate over small areas are easy to account for. Brighton, for example, facing the southern sun, and protected by the range of South Downs from the cold north and east winds, enjoys a mean annual temperature higher than places near but less favoured.

Climate does not depend upon the vegetable covering of a country, since vegetation is the result rather than the cause of climatic conditions, but on meteorological phenomena affecting altitude and wide spread spaces. These phenomena remain even when vast expanses of forest are removed, marshes drained, and deserts irrigated by human industry, to which agency, and not to difference of climate, must the beneficial effects thereby produced be accounted due.

CHART OF FLORAL REGIONS OR BOTANICAL DISTRICTS.

| Region. | Limits. | Characteristics. | Analogue. |
|---|---|---|---|
| Iberian or Asturian. | S. W. Ireland, Cornwall, and Devon. | Humidity. Evergreens. | Madeira and N. Spain. |
| Armorican . | S. & W. England, Channel Islands, S. E. Ireland. | Pastures and Orchard Fruits. | Normandy and Brittany. |
| Germanic . | N. & Central Ireland, Central England, Scotch Lowlands. | Deciduous Trees and Green Vegetables. | Germany and Mid-Europe. |
| Boreal, Arctic, or Scandinavian. | Extreme N. Ireland, Scottish Highlands, Eng. Lake District. | Fir Trees and Berries. | Alps, Sweden, Lapland. |

## CHAPTER III.

### INFLUENCES OF GEOLOGY ON THE INDUSTRIAL HISTORY OF THE BRITISH RACE.

### INTRODUCTORY.

General Physical Geography of England as dependent on its Geology —Geological Distribution of Mineral Products—Minerals in Veins —Influence of Igneous Rocks on the Development of Minerals in Veins—Bedded Mineral Deposits—Coal and Iron, and Association of, in their Relation to Industrial Pursuits—Relation of Geology to Agriculture—Botanical Aspect presented by Geological Formations — Influence of Certain Constituents of Rocks on the Growth of Plants — Comparison between other Countries and Parts of Great Britain—Table.

While regarding the climatic zones, we have been conscious that other agencies are at work; that plants, although of the same character, flourish more in one part of a botanical zone than in another; and that animals vary in like degree, being dependent upon plant food, either directly, by cropping the herbage, or indirectly, by preying upon the vegetable feeders.

Within the small compass of our own islands, the Grampians are bare and sterile, while the Welsh mountains and the chalk Downs are clothed with turf to their summits. Plains are *here* chill marsh land; *there*, rich soil waving with golden grain. Multitudes of people crowd together on land covered with noisy "works" and mills, under sombre skies blackened with smoke from furnace fires. In another place, with sunlit atmosphere and fields smiling with fertility, the "next-door neighbour" is a mile away.

Further than this, there are certain species of plants, special and wholly confined to limited areas. Such are an *Arenaria* and a *Cerastium* of the Shetlands, the *Erica* of Cornwall, and the *Orobanche* of parts of Ireland. The prevalence of other species favouring nature-selected spots, is well known to every practical botanist. The law holds good with farms and farming. Husbandmen consider what crops will best repay their labour, and differ in their operations. The sites of the Kentish cherry orchards could not be exchanged to advantage with those of the Hereford apple orchards or the pear orchards of Worcestershire; nor could the hop gardens of Surrey and Hants any better change their station with the Devonshire dairy farms or the East Anglian fields of corn.

The reason is not far to seek. Plant-life depends both upon the soil and upon the climate which stimulates vitality. Plants differ in the constituents of their tissues; and the affinity which their roots possess for certain substances, to the exclusion of others, can only be shown and exerted where such substances are present.

Students of nature are led to investigate geological structure, and the agriculturist calls chemistry to his aid to analyse the soil. Thus the Shetland plants to which allusion has been made, are found only on the serpentine rock; the Irish *Orobanche*, only on the basalt; and the Cornish *Erica* follows the metalliferous veins of that mining county. In the West of England, the Old Red Sandstone is eminently suited for fruit culture; while the *Cornbrash* of the *Oolite* disintegrates into a rich wheat-bearing soil, self-manured with the phosphate of lime or bone-earth, of which the rock largely consists.

Again, the *Trias* and other *Poikilitic* (variegated) strata, crossing England from the Tyne to the Exe, comprise an undulating country adapted both for wheat-growing and for

the production of fruit. The *Lias* which follows, yields the finest cheese in England, while it is also a good soil for apples and grain. Very interesting is this range in its physical geography and geology. Within its bounds occur the river valleys of the Ouse, Trent, Severn, and, as an outlier, that of the Eden at Carlisle. We have likewise the Cheshire plain in the north-west, together with the vales of Exeter and Taunton in the south-west.

Let us notice how this formation covers every notable spot of English cheese production. "Prime Old Cheshire" owes its excellence to the rocks which traverse the county. "Stilton," in Huntingdon, gives a designation to the choicest cheese, made over an area of the same formation, spreading into the neighbouring Leicestershire. "Double Gloucester" is produced along the Severn bank; and the "Vale of Cheddar," a district of Somerset, where the Lias combines with the Triassic red marl, furnishes Cheddar cheese, the fourth, and by many thought the crowning type of English manufacture.

The river valleys of the Trias are just as distinctive for the production of corn. From the time of Roman Britain, the Plain of York, formed of the valleys of the Ouse and its tributaries, has been the largest low-lying cornfield and meadow land in our country. Yorkshire circumscribes a perfect drainage area of many rivers connected with the Humber. Resting upon the Triassic strata, the lower reach of the plain is overlaid by a rich, deep alluvium, in the midst of which lies York, the ancient provincial capital Eboracum.

Characteristic of the Triassic rocks is the link they form between the oldest (Palæozoic) and the more recent formations (Mesozoic and Cainozoic). To the west of the line of the Trias occur Primary rocks, while to the east spread out, to a greater degree and less disturbed, the Secondary and

Tertiary systems. In other words, the Primary rocks constitute the hills and mountains of the west, while the Tertiaries form the eastern plain. A geological map of Great Britain shows the island to present in its rock groups an epitome of the geological structure of Europe. Such a map might almost serve for a diagrammatic chart of the earth's crust. From the Atlantic seaboard to the German Ocean we trace the formations, in due geological sequence according to age, with their escarpments roughly parallel from south-west to north-east and facing the North Atlantic.

Two great geological tracts are thus well marked. The north-westward tract comprises the kingdom of Scotland, the English Pennine range, the Cumbrian and Cambrian mountain groups, together with the peninsula of Devon and Cornwall. South-eastward is the whole level outspread of England, which, though undulating in parts, traversed by downs of chalk and interspersed with isolated hills, preserves its character of a great plain; which shelves down from the central table-land and the river basin of the Yorkshire Ouse, through the depressed Fen district and the nether-lands contiguous to the Wash; and from the upper valley of the Thames to the sea-reach and East Anglian mud-flats.

The diversity of rock structure of the British Islands is nowhere exceeded within the same small expanse. Such variety is thereby given to the landscape, that the point of the poetical description of Ireland as the Emerald Isle, lies in its truth. The ubiquitous grasses differ in kind according to the soil; the food grains flourishing in the silicious alluvium, and perishing elsewhere. Nevertheless, it is not in the superficial aspect or *facies* of our islands that the influence of the rock structure is chiefly displayed.

An elementary acquaintance with the physical geology of the United Kingdom, and a bird's eye view of the rocks as placed in position, are requisite in order to enter with

advantage into these inquiries. The occurrence of metals and fuel in the line of disruption of the stratified by the igneous rocks determines the local industries of mining in contrast to the husbandry of the plains, and the presence of useful minerals, metals, and earth. West of a line drawn from the mouth of the Tees on the north-east, to Lyme Regis on the south-west, the chief occupations are mining and manufactures, while east of that line agriculture prevails.

## *GENERAL PHYSICAL GEOGRAPHY OF ENGLAND AS DEPENDENT ON ITS GEOLOGY.*

The rocks of Great Britain are divided, according to the origin of their present condition, into two great classes and one sub-class—viz., *aqueous* rocks, formed by the action of water; *igneous* rocks, formed by the action of fire; and *metamorphic* rocks, which, originally stratified or aqueous, have since been changed in their texture by igneous action.

Igneous and metamorphic rocks comprise only a small proportion of the rocks of England and Wales. In North Wales they appear largely in the counties of Merioneth, Caernarvon, and Anglesea; and for twenty miles eastward of St. David's Head igneous rocks are variously distributed. Rocks of these groups constitute the Grampians, the South Highlands of Scotland, the Cheviots, and the Malverns; they occur too in Derbyshire, Worcestershire, Charnwood Forest, Devon, and Cornwall, whilst the midland, southern, and eastern parts of England are devoid of them.

Aqueous rocks, constituting by far the greater proportion of the rocks, form, in our island, a number of beds arranged in succession one upon the other, each set of beds, or *formations*, presenting peculiarities which enable the geologist to recognise and place them in a serial order, which order is irreversible.

In the west, in Devon, Cornwall, and in Wales; in the north-west, in Cumberland; and in the Pennine chain, which stretches from Northumberland to Derbyshire, we have the chief mountainous and hilly tracts of England and Wales; all of which are composed of Palæozoic rocks, elevated by the disturbances to which they have been subjected.

If we pass from the older rocks of South Wales and the border counties in an easterly direction, as from the neighbourhood of Gloucester to London, to the newer and less disturbed rocks, we find that these present low undulating grounds and plains of New Red Sandstone and Lias, succeeded by two great escarpments, the edges of table-lands, of not more than 1000 feet above the sea, sloping toward the east. The western escarpment, as seen in the Cotswold Hills, is formed by the Oolitic, and the eastern by the Cretaceous or chalk strata; the Tertiary, comprising on the east the London, and on the south the Hampshire basins, overlie the chalk.

This physical structure of England is represented in the following generalised section:—

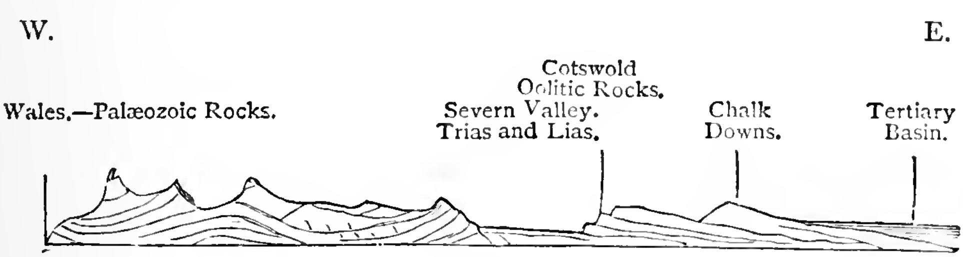


Fig. 1.

If we examine the country farther north, say from Snowdon to Flamborough Head, the arrangement of strata will be found very similar to that observed in the line of the southern section. Thus, in the west rise the disturbed Palæozoic strata which form the mountain region of North Wales; in Flint and Denbigh Carboniferous rocks appear;

then in Cheshire lies the great plain of New Red Sandstone, from underneath which rise, in Derbyshire, the Carboniferous strata, forming the high grounds in that county; these are succeeded by the low escarpment of the magnesian limestone of the Permian system; and then come plains of New Red Sandstone again, crowned by the escarpment of the narrow strip of Oolite, and by that of the Cretaceous rocks.

This structure explains the course of the larger rivers. The principal watershed of the country is the tract of high ground extending from the north of Scotland far into England; it is nearer to the west coast than to the east, and therefore a much larger area of country is drained towards the east than towards the west. All the larger rivers—with the exception of the Severn and its tributaries—run into the German Ocean. The plains, which occupy much of the middle and east of England, are traversed by many tidal rivers, and from the nature of the country the construction of canals has been a comparatively easy task. These physical features can be taken in at a glance by means of the appended Summary of British Rocks. (*See Diagrams.*)

## *GEOLOGICAL DISTRIBUTION OF MINERAL PRODUCTS.*

Regarding the soil and the productive industries of the country, one is as much struck with the contrast between the occupations of the people in the West and the East, as between the geological features. Differences of conditions produce differences of a remarkable kind in the populations of the respective districts, the one being as distinct from the other in appearance, habits, character, dialect, and aspirations, as in productive pursuits. Mining for metals and fuel; quarrying for building and other stones; manufactures and foreign commerce, characterise the vocations of the people of the West and North, and husbandry is in the

background; while over the Eastern and South-eastern plains, agriculture is wholly in the ascendant, manufactures are quite a minor industry, and mining has no place.

Further we observe that densely massed populations aggregate in great towns on the coalfields and around the mining centres, such as Glasgow, Manchester, Leeds, Sheffield, Newcastle, and Birmingham, while over the agricultural area there are few towns aspiring to magnitude, and the population is sparsely scattered. Time was, not so far back as to constitute an important period in a nation's life, when Lancashire, the West Riding, and the busy mining region of South Wales were as thinly inhabited as the moorlands. The "Black Country" was then, like the rest of Stafford and Warwick, a quiet pastoral district. The great towns were Beverley, Cambridge, Dorchester, Lewes, Old and New Sarum, Shaftesbury, Wallingford, and Winchester, all important places in mediæval days, and all standing on the Cretaceous downs or wolds, where not a town of any magnitude is now to be found.

Until recent changes, England was mainly an agricultural and grazing country, and in its early history, almost wholly so. Under the Romans, cereals enough for export were produced, and the river valleys were the chief corn-growing parts of Britain. These facts are illustrated in the sites of the principal Roman towns, to some of which we have referred; as the provincial capital of York (Eboracum) on the Trias of the Ouse, and Winchester in the Tertiary vale of the Itchin. Thus, too, the cities of London and St. Albans were founded in the Tertiary vale of the Thames, and Lincoln, Cirencester, Bath, and Dorchester were placed upon the rich Oolite and Freestone of central England. If we trace the rise of the towns of the early English period, the same rule obtains, of occupying the cultivable valleys and the gentle plains,—plainly verified in the Kentish

capitals of Canterbury and Rochester; Norwich, Bury St. Edmunds, and Ipswich, Peterborough and Ely, Lincoln and Oxford.

Some of the early towns have disappeared; nearly all have declined, losing their note as markets and centres of trade, and sustaining their name and fame solely as cathedral cities. The course of events has totally reversed the relation between the two great geological divisions of the country. Our great towns and populations are now spread over the Palæozoic formations, and although tillage is still the greatest of our single industries, and still tends to enlarge, mining, manufactures, and foreign commerce have advanced at such a rapid pace, that agriculture has, relatively, been left in the background.

How special the relation has grown between the progress of society and that of localities, is illustrated in the case of industrial communities wholly supported by cleaving slate, mining rock-salt, or making clay tobacco pipes. Flourishing seaports also abound whose existence rests exclusively upon their convenience as points of arrival and departure of our mercantile marine, and as depôts of merchandise. We have only to be told the character of a locality to be able to form an opinion of the occupations of the people, and, conversely, the occupations of the people, to know the character of a locality. A brief review of our mineral resources, with some reference to foreign production, will enable us to co-relate the kingdom of minerals with the phenomena of our industrial life.

### I. Minerals in Veins.

The modes of occurrence of minerals are (1) in veins or lodes; (2) in regular or irregular beds; (3) in connection with detrital matters.

Great Britain possesses rich supplies of minerals. Almost every variety is represented, and the most useful in vast

quantities. Of the metals there are gold, silver, copper, lead, zinc, tin, antimony, nickel, graphite, cobalt, bismuth, besides the newly extracted metals from the aluminous and magnesian earths. Some of the rarest metals, such as uranium and chromium, are also found, while others, like sodium and potassium, are only produced in the laboratory. Above all, ores of iron exist in profusion, enabling us to build thereon our industrial and commercial supremacy.

Of minerals other than metals, our Coal Measures yield, as yet, more invaluable fuel than all the rest of Europe, if not of the world, while building stones and the economic earths occupy a not less important place among the resources of national industry and wealth.

The lodes from which we derive our chief supply of metals are almost confined to Palæozoic rocks. Their occurrence may be sketched as follows :—

The Silurian formation in North Wales, in the Isle of Man, in Cumberland, in the Lead Hills of the south of Scotland, in parts of the Highlands, and in parts of Ireland, contains metalliferous veins which yield gold, ores of copper, lead, silver, antimony, arsenic, and zinc.

The rocks of the Devonian formation in Devon and Cornwall contain rich tin, copper, and lead lodes.

The Carboniferous Limestone in Derbyshire, ranging up to the north of England through Cumberland and the adjacent counties, also of the Mendips, and in Devon, is the chief depository of our lead ores. The same formation contains large and rich deposits of hæmatite, an ore of iron, as in the Forest of Dean, Somersetshire, and Cumberland.

Throughout the world, all the metalliferous lodes, with some peculiar exceptions hereafter to be mentioned, occur in stratified or the associated igneous rocks, not newer than the Permian. It is thus that one generalisation in the inquiry is arrived at, viz., that of the *period* during which the

lodes carrying our richer metals were filled. Geology, like the more exact sciences, is capable of advancing philosophical inductions to very important results. Sir Roderick Murchison was enabled in 1844, from the study of the gold-bearing tracts in Russia, to predict the discovery of gold in Australia.

Mineral veins occur in igneous as well as in aqueous rocks; but the intrusion of an igneous mass among stratified deposits appears to have rendered their lodes richer than elsewhere, amid conditions in other respects similar.

Gold is usually found in a quartz matrix, traversing Palæozoic shales, chiefly those of the Lower Silurian epoch; and the auriferous lodes are frequently richest in the vicinity of eruptive rocks. The precious metal is found also in Secondary rocks, such as those of California, Peru, and Bolivia, yet under circumstances exceptional to the *usual mode of association of gold.* It appears that where certain igneous eruptions, of diorite especially, have penetrated the Secondary strata, the latter have been rendered auriferous for a limited distance only beyond the junction of the two rocks; and it is concluded that all Secondary and Tertiary deposits, excepting the auriferous detritus of the latter, not so specially affected, never contain gold.

The lodes carrying copper and tin in Cornwall and Devon are richest about the junction of the *killas* (local name for the slaty rocks of the Devonian formation in this district), and the bosses of granite, and where they are intersected by granitic dykes, termed *elvans.* It is worthy of remark that these metalliferous veins have a course or strike nearly east and west, and that these phenomena are not confined to this area, but are exhibited in Saxony and elsewhere.

II. Bedded Mineral Deposits.

These include coal and iron ore, of primary importance;

and salt, gypsum, cement-stones, coprolites, iron-pyrites, bituminous shales, &c., of secondary value.

(*a.*) *Coal* occurs in many formations; it has been mined for upwards of a hundred years at Brora, in Sutherlandshire, in rocks of the Oolitic epoch, and is worked at Bovey Tracey, Devonshire, in Miocene beds. An anthracite occurs in the Devonian rocks in Spain; there are good workable coals of the age of the Trias in Virginia and Hindostan, and of that of the Lias in Hungary; and less valuable coals, chiefly brown coals, occur in Tertiary strata in Austria and other parts of Germany. The richest and largest supplies are, however, drawn from the Carboniferous system in Great Britain, Belgium, United States, Nova Scotia, and Australia.

In Great Britain no coal is found below the Carboniferous strata, but it does occur in newer strata. In the midland and south-western counties of England, and in South Wales, it is confined to the true Coal Measures underlain by the Millstone Grit, locally called the "farewell rock," because, in the language of the miner, when that rock is reached, one bids farewell to the coal. In the north of England and in Scotland, workable coal seams occur in the inferior formations of the Carboniferous system, as well as in the Coal Measures.

A correct knowledge of the law of superposition of rocks in relation to our coal-bearing strata, is of value not only to the man of science, but to every speculator in mines, and to every landed proprietor who cares to understand the mineral value of his property. Not long ago, considerable funds were spent at Tullygirvan, Co. Down, in a useless search for coal. The adventurer had set to work in black Silurian shales, their mineral aspect resembling that of certain coaly strata, with which he was, perhaps, familiar; but had he possessed even a slight acquaintance with

organic remains, he would have abandoned his experiment at the commencement, for the shales were charged with graptolites. Now the scientific miner knows that rocks containing graptolites and trilobites existed untold ages before the epoch of the coal strata. When he meets with those remains, he concludes that money spent in search of coal beneath them will be turned into irredeemable dust, for they occupy, in the irreversible order of deposits, a position thousands of feet beneath the Coal Measures.

Lord Londonderry bored in the Old Red Sandstone, at Mount Stewart, Co. Down, in search of coal; here, though no fossils occurred, yet the position of the Sandstone strata above the previously mentioned Silurian shales, and overlain as they are by Mountain Limestone, proved the impossibility of coal being found.

In the neighbourhood of Carrickfergus are two silent witnesses of the folly of sinking for coal where the geological structure of the country precludes the possibility of its presence, or of its occurrence at reasonable depths. Trial shafts had been sunk in New Red Sandstone, which was pierced to a depth of about 1000 feet, when the adventures were abandoned. Before coal could be reached, the Permian strata would have to be passed through; and from the unconformability of the New Red Sandstone to the Permian, and of that set of strata to underlying formations in this district, it was even doubtful if coal could be reached at all.

But coal has been successfully reached by the penetration of newer unconformable strata; thus, in the Somersetshire coalfield, the coal shafts pass through New Red Sandstone, the Permian strata being absent. The famous Monkwearmouth pit passes through 330 feet of overlying Permian rocks.

In these and other instances that might be adduced, the undertakings had been commenced at the suggestions of those who were perfectly satisfied, from an examination of the surrounding country, of the feasibility of the venture. Yet, on the other hand, attempts have been made to reach coal from below secondary rocks, when, with but a broad knowledge of the geological structure of the country, the trials should have been at the outset abandoned. Thus, at Kingsthorpe, near Northampton, a shaft was sunk through the Lower Oolite and Lias, at an expenditure of nearly £30,000; the adventurers desisted when they reached the New Red Sandstone. A similar trial took place near Lyme Regis, the Lias being bored for coal at an expense of several thousand pounds; the deception was fostered by the accident of passing through a *piece* of lignite.

(*b.*) *Iron Ores.*—Certain ores of Iron occur in lodes in primary strata, but others, especially the spathic and brown hæmatite ores, are intercalated as bands among shales and limestones of the Carboniferous, Liassic, Oolitic, Wealden, and Cretaceous strata; but by far the largest supply is obtained from the Carboniferous system, the same shaft often communicating with both coal and ironstone workings, and the same group of rocks furnishing limestone.

The Carboniferous system contains our greatest sources of mineral wealth. It yields the coal which gladdens our hearths and heats our roaring furnaces. It supplies us with iron ores and lime, and with the fuel necessary for smelting the iron, for the most part in close proximity to the ores. We have thus three conditions favourable to the production of cheap iron—abundant ore and fuel, with limestone as a flux—occurring together. In no other country perhaps, save Belgium, do we find an equally favourable combination of circumstances. The absence from Ireland of any vast deposits

of bituminous coal naturally prevents the establishment in that country of those branches of industry in which the cost of fuel forms any very large proportion of the total cost of production. Hence, we have not had there any successful establishment of iron-smelting in recent times. The iron ores, however, both as earthy and bituminous carbonates and as hæmatites, are now largely exported from Ireland to England and Scotland to supply the enormously increasing demand.

Large quantities of copper and other ores raised in Ireland, Chili, and Mexico, are sent to Swansea to be smelted, as the proportion of fuel which is required would render the process in those countries too costly to be profitable. In other words, it is cheaper to carry ore to the coal, than coal to the ore. Similarly the various clays raised in the south of England are transported to Staffordshire to be converted into useful articles.

Previous to the employment of steam as a motive force, water was the prime mover; consequently our manufactories, at that time, were located where water-power was at command. On the application of coal to the generation of steam, the seats of manufacturing industry were necessarily transported to the districts where this mineral could be obtained abundantly and cheaply. Norwich, York, and Spitalfields could then no longer compete with the towns more favourably circumstanced, and in course of time ceased to be the great manufacturing centres. Lancashire, on the introduction of steam machinery, soon became the greatest manufacturing district, owing to its situation with respect to our coal-fields and to our outlets of commercial industry.

From the time of the Romans to the seventeenth century the Weald of Kent and Sussex was one of the chief sites for the production of iron, because of the close proximity of the fuel, wood, to the ore; but when coal

came to be used in the reduction of the ores, this branch of industry declined, and was soon removed to districts where the more abundant and cheaper supply of fuel was to be found.

(*c.*) *Other bedded mineral products* are met with in strata of various ages. Slates are quarried in Silurian rocks in Caernarvon and Merioneth, in Cumberland, and in some parts of Scotland. In these districts there is a very large population supported entirely by the quarrying and preparing of slates.

Rock salt is confined in Great Britain to the Keuper sandstone and marls.

(*d.*) *Building and architectural stones* are chiefly quarried in the Devonian, Carboniferous, Permian, and Oolitic strata.

The mining of *Iron Pyrites* is a large branch of industry in Ireland, and the basis of an extensive series of chemical manufactures in which the cost of fuel does not form a preponderating item. This mineral is collected in Scotland, and the north-eastern parts of England, being derived from the Carboniferous and the newer formations.

(*e.*) *Coprolites*, the excreta of extinct gigantic reptiles, and *pseudo-coprolites*, the osseous remains of large vertebrates, and nodular concretions of phosphate of lime of organic origin, cannot be expected to occur in strata of an epoch anterior to that in which those animals lived. They occur in the Liassic, Neocomian, and Cretaceous strata, and in the newer Tertiaries, these last formations being characterised by the remains of whales and other mammals, as the first are by *ichthyosauri*, *plesiosauri*, and other huge reptiles. As a source of manure, coprolites have become important.

**III. Detrital.**

The chief minerals found in detrital deposits are gold and tin-stone, *i.e.*, stream-tin. Being derivative, the oc-

currence of these minerals indicates the existence of rocks containing them, either in the immediate neighbourhood, or in tracts drained by a local stream or its tributaries.

Keeping in view the geographical distribution of the palæozoic rocks, especially of the Silurian, Devonian, and Carboniferous systems, and the fact of these strata being the sources of our chief mineral wealth, let us now apply these phenomena to the industrial pursuits of the people of these areas.

## *RELATION OF GEOLOGY TO AGRICULTURE.*

### I. Botanical Aspects presented by Geological Formations.

Agriculture, the first in time as in importance of all human industries, is the phase of labour which, above every other, bears the closest relation to geological conditions. While tracing our greatest manufactures and densest aggregations of the people, to the sites of seams of iron-stone and other metal-bearing rocks, or deep-buried beds of coal, we have been unable to avoid a glance at the superficial or botanical aspect of the scenery. The soil in which plants flourish is derived from the subjacent rocks, and its fertility is due to the greater or less abundance of those mineral constituents which enter into plant structure.

The conditions of the best soils are (1) depth; (2) texture; (3) fertility. All rocks exposed to the agencies of heat and frost, wind and rain, more or less rapidly decay. Glaciers grind their sides into moraines or streams of grit. The oxygen of the atmosphere corrodes their surface, which winds, storms, and floods tear or wash away, and the alternations of the summer heats and winter frosts cause to shiver off to the base. Spreading outward from their origin, the varied accumulations of decomposed rock form a superficial layer or soil, which is deep or thin in proportion to the readiness

with which the rock itself disintegrates. Thus we arrive at the *depth* of soils as one of the characters favourable to vegetation.

By the *texture* is meant the grain into which the rocks from which soils are derived have a tendency to crumble. This texture ranges between the pure silicious barren grit of the seashore and pathless desert and the tenacious clays which specially characterise English soils, and render husbandry more arduous and costly than it is abroad. The high farming in Great Britain has for its main object to improve the texture of the soils by deep draining, sub-soiling, and manuring, that is, by mixing with the soils such other substances as are either absent or deficient. The larger the number of mineral constituents, other conditions being equal, the richer or more fertile the soil. Igneous or crystalline rocks, from the variety of their component parts, form, when thoroughly decomposed, excellent soils, which cultivation readily makes still more fertile.

River banks are washed away by the streams, and redeposited as mud flats or low shores near their estuaries; which by embankment are converted into fertile fields and the richest pastures. Such, for example, are the Nilotic mud swamps which form the Delta of Egypt, or the rich grazing grounds of our own Essex marshes maintained along the left bank of the Thames from London to the Nore, since the days of the Roman occupation.

The depth of soils is susceptible of indefinite increase by the natural decay and renewal, through ages, of the surface vegetation. The annual fall of the leaf in great forests accumulates *humus* or mould to such a degree, that extant forests spring from the soil of ancient forests, buried beneath, one upon another, through periods beyond computation. Bog, to an unknown depth, has in many countries, like Ireland, been produced in a similar manner, from effete

vegetation. Applying these principles to the soils of Great Britain, we get a clear comprehension of the following facts.

The western parts of Wales, where the land attains an elevation of from 2000 to 4000 feet above the sea-level, are covered with heath, and are only fit for inferior pasture lands. Monmouthshire, Brecknockshire, Hereford, and parts of Worcestershire are occupied by the rocks of the Old Red Sandstone formation; and in consequence of their susceptibility of decomposition, the marls breaking up into rich earth fitted for tillage, they naturally form a more fertile soil than that derived from the slates of the west; hence we have in the former districts good corn lands and productive orchards.

The configuration of the surface of the country occupied by the Jurassic rocks which succeed the Old Red Sandstone formation and the low plain of the New Red Sandstone, may be viewed as an alternation of clays and limestones. The outcrops of the clays can actually be traced by the wide valleys, which are permanent grass lands; whilst the limestones compose ranges of low hills or more elevated grounds. These limestone ridges form escarpments (see Fig. 1, p. 25), along the line of strike, that is, on the sides (N.W.) on which the several clays rise up from beneath the calcareous beds. The soil on these limestones is well adapted for the growth of cereals, turnips, and clovers.

Passing on to the Cretaceous series, which in the south form extensive tracts, we meet with silicious, argillaceous, and calcareous soils. The rocks in the western part of the Wealden area contain little lime and much silica, and are covered by some very widespread heaths not worth bringing into cultivation. The natural forest-lands of the Weald or Wold are on the Wealden Clay, which has been cultivated, though only of late years, by the help of deep drainage.

The base of the chalk escarpment is usually marked by a stratum of clay—the Gault—which thus occupies a valley, and is a pasture tract. But the chalk strata which form the South Downs and stretch far to the west, into the centre of England, and thence away to the north-east, are chiefly used for the purpose of sheep-pasturage. There is little or no soil upon them, the herbage is short, and trees are absent. The chalk ranges, however, especially the broad, sweeping plain of Wiltshire and Hampshire, are gradually coming under tillage, the chief crops being grain, turnips, clover, and sainfoin.

The soils derived from the decomposition of rocks containing magnesia—such as the dolomite of the Permian, which ranges from Nottingham, through Derbyshire and Yorkshire, to Tynemouth, and the serpentines of Cornwall—are rich, but perhaps less so than those derived from ordinary calcareous strata. The Lizard Downs are, however, reckoned fine pasture-land, the cultivated parts are amongst the best corn-lands in the county; and agriculturists agree that the land on the Permian tracts is extremely fertile.

The Tertiary beds of the basin of the Thames are for the most part cultivated tracts, excepting where the Bagshot Sands form the superficial stratum. These are familiar to us as heathy wastes, such as Aldershot Heath, Bagshot Heath, Hampstead Heath, and have been converted into camping and exercise grounds for our troops and volunteers.

The older palæozoic rocks, although rich in minerals, are generally barren, and seem peculiarly dreary and desolate. This arises partly from the nature of the strata, and partly from the circumstance that, occupying hilly regions, they are to a great extent above the limits of the growth of economic plants, even if within the reach of ordinary agricultural operations.

The Highlands of Scotland, composed of masses of gneiss and granite, are heathy and barren, since their hard rocky materials come almost everywhere bare to the surface, forming a wild pastoral country, browsed by black cattle, poor sheep, and red deer. The neighbourhood of Parys Mountain, in Anglesea, is singularly marked by sterility and gloominess—there is neither shrub nor tree, and the barrenness is unrelieved even by a single blade of grass. Other examples might be adduced in illustration of the unproductive nature of the soil of the oldest palæozoic and metamorphic rocks. In all these regions the character of the surface will be more or less modified by the occurrence of *alluvial* deposits bordering the rivers, and by the presence of a glacial drift—the effect of denudation upon various rocks, producing a favourable mixture of clay, sand, and lime, which forms a rich soil. "We must bear in mind that these bare and barren mountain masses are not examples of soils, but of the original and still undecomposed and undisintegrated rock structure."

### II. Influence of certain Constituents of Rocks on the Growth of Plants.

Rocks may be divided into three classes—silicious, argillaceous, and calcareous. Silicious rocks of soft nature produce light soils, which are the least productive; whilst the hard, intractable grits form little soil, because they are difficult to decompose, and that little is to a great extent barren. The slaty rocks present the same superficial aspects as those of the hard grits; but the soft argillaceous soils, from their power of retaining water, are heavy, and are usually laid out into permanent pasture-lands. The pure calcareous strata, as chalk, though forming soils ranking amongst our richest, are not to be compared with those resulting from the disintegration of more mixed rocks.

*Inorganic Constituents of Plants.*

A plant is compounded of two sets of constituents, the organic and inorganic; the former is derived from water and the atmosphere, whilst the latter is obtained from the soil. Now the quantity of inorganic food required by different vegetables is greater or less according to their nature; and if a soil be of such a kind that it can yield only a small quantity of this inorganic food, then those plants will only grow well upon it for which this small supply will prove sufficient. Thus trees may grow where arable crops often fail to thrive, because many of the former require and contain comparatively little inorganic matter.

TABLE OF THE PROPORTION OF INORGANIC MATTER IN 1000 POUNDS OF THE FOLLOWING SUBSTANCES.

| | lbs. | | lbs. | | lbs. |
|---|---|---|---|---|---|
| Wheat, about | 20 | Oak Wood | 2 | Peas | 50 |
| Oats | 40 | Pine Wood | 1½ to 3 | Turnips | 5 to 8 |
| Barley | 30 | Wheat Straw | 50 | Ash Wood | 1 to 6 |
| Beans | 3 | Oat ,, | 60 | Elm Wood | 19 |
| Clover | 90 | Barley ,, | 50 | Elm Leaves | 100 |

Meadow Hay, 50 to 100 lbs.

From the above table it appears that the quantity of inorganic matter varies in different parts of the same plants—as for example, the straw of our crops contains more ash than the grain. In trees and plants the leaves are richer in inorganic matter than the wood or stalk.

The quality of the ashes of plants varies with the same conditions by which the quantity is affected. The more commonly occurring mineral substances in them are—phosphates of lime, soda, potash, and magnesia; carbonates of soda and lime; chlorides of potassium and sodium; sulphates of soda and potash; iron and silica.*

* For analyses of the *ashes of* SEAWEEDS from the Scotch coast by Dr. J. Yeats, and their economic value, by Professor J. Anderson, see *Transactions of the Highland and Agricultural Society of Scotland*, No. 33, New Series, p. 448 *et seq.*

TABLE OF THE QUANTITY OF INORGANIC MATTER IN VARIOUS SPECIES OF PLANTS.

| | Wheat. | Barley. | Oats. | Rye. | Indian Corn. | Beans. | Linseed. | Potato. | Turnip. |
|---|---|---|---|---|---|---|---|---|---|
| Potash . . . | 237 | 136 | 262 | 220 | 325 | 336 | 245 | 557 | 419 |
| Soda . . . | 91 | 81 | — | 116 | | 106 | 34 | 19 | 51 |
| Lime . . . | 28 | 26 | 60 | 49 | 14 | 58 | 147 | 20 | 136 |
| Magnesia . . | 120 | 75 | 100 | 103 | 162 | 80 | 99 | 53 | 53 |
| Oxide of Iron . | 7 | 15 | 4 | 13 | 3 | 6 | 19 | 5 | 13 |
| Phosphoric Acid . | 500 | 390 | 438 | 495 | 449 | 380 | 381 | 126 | 76 |
| Sulphuric Acid . | 3 | 1 | 105 | 9 | 28 | 10 | 9 | 136 | 136 |
| Silica . . . | 12 | 273 | 27 | 4 | 14 | 12 | 57 | 42 | 79 |
| Chlorine . . | — | tr. | 3 | — | 2 | 7 | 3 | 42 | 36 |
| | 998 | 997 | 999 | 1009 | 997 | 995 | 994 | 1000 | 999 |

We deduce from the foregoing table that a crop of wheat will extract from the soil certain ingredients, while beans and potatoes will extract others. Hence a piece of land may suit one kind of crop and not another. Hence, also, two successive crops of different kinds may grow well where it would greatly injure the soil to take two in succession of the same kind; and it is also evident that the cereals contain phosphates, and that there is much potash in potatoes and turnips; while beans and most leguminous plants contain lime.

As the straw of cereal plants contains comparatively little of some of the ingredients found in the ear, such as lime, magnesia, and phosphoric acid—the straw and ash being especially rich in silica—so the roots may in certain plants and in certain soils succeed in fully nourishing the straw, while they cannot fructify the ear; or the very reverse of this may occur.

*Sources of the Inorganic Constituents of plants and the*

*Agricultural Capabilities of soils derived from various Geological Epochs.*

As the inorganic compounds are derived from the soil or from manure supplied to it, the adaptation of certain crops to given land will be dependent upon the chemical composition of the rock from which the soil is derived. Soils derived from rocks devoid of phosphates cannot produce cereals, whilst soils produced from the decomposition of rocks that contain the inorganic constituents of cereals are necessarily the best adapted for the growth of such crops.

Dr. Daubeny experimented upon the relative amount of phosphoric acid obtained from barley sown in pulverised samples of various strata of different geological epochs, and he found that whatever the age of the rock might be, provided it belonged to a series in which organic remains were present, phosphoric acid was one of the constituents of the rock. On the other hand, phosphoric acid was absent in certain slates which lie below the oldest rocks in which organic remains have been detected—such, for instance, as those of Nant Francon, Llanberis, near Bangor, to the north of Dolgelly; schist taken from the foot of Snowdon; mica-schist from Loch Lomond; and certain specimens from the Longmynd Mountains.

The reclamation of those great tracts of land, the peat-bogs in Ireland, for the purposes of agriculture, has occupied a very large amount of attention. The progress of chemistry in later years has divested the question of much of the paramount importance that was formerly attached to it. By the researches of Liebig and others the true principles of the growth of agricultural crops are understood; it is well known that, even if thoroughly drained, peat will not supply the materials necessary for the production of food, and that the cost of introducing those materials in the form of

manures, if applied to land in better condition occupying the same area, will yield greater and more profitable returns.

An examination of the chemical components of the following rocks, the soils of which form our finest corn-growing lands, will show the practical advantage of geological and chemical knowledge, and explain the great difference in the respective producing powers of such soils :—

| | Inferior Oolite. | Great Oolite. | Cornbrash. |
|---|---|---|---|
| Carbonate of Lime | 89.20 | 95.346 | 89.195 |
| Magnesia | .34 | .739 | .771 |
| Sulphate of Lime | .09 | .204 | .241 |
| Alumina | 4.14 | 1.422 | 2.978 |
| Phosphoric Acid | .06 | .124 | .177 |
| Soluble Silica | 2.75 | 1.016 | 1.231 |
| Insoluble Silica | 3.27 | .533 | 4.827 |
| | 99.85 | 99.384 | 99.420 |

These analyses show that phosphoric acid and sulphate of lime—two important chemical substances in the growth of crops—greatly predominate in the Cornbrash, and are in excess in the Great Oolite above the Inferior Oolite. The yield of corn, in bushels, of a fair average crop grown upon an acre, will be seen to be proportionate to the amount of these chemical substances in the soil, the one containing the largest amount of these salts affording regularly the largest crop :—

| | Inferior Oolite. | Great Oolite. | Cornbrash. |
|---|---|---|---|
| Wheat (bushels) | 15 to 20 | 20 to 25 | 25 to 30 |
| Barley ,, | 25 ,, 30 | 30 ,, 35 | 40 ,, 45 |
| Oats ,, | 25 ,, 30 | 35 ,, 40 | 45 ,, 50 |

The average rents of these three varieties of soils correspond to their greater or less fertility; those of the Great Oolite approaching twice, and those of the Corn-

brash three times, the amount demanded for the inferior Oolite.

**III. Comparison between other Countries and parts of Great Britain.**

Since the rocks of *Normandy* and *Picardy* are identical with those of our midland and southern counties—being of Oolite and Cretaceous age—we should infer that the inhabitants are agricultural, the chalk tracts being occupied by pasturage, the limestone of the Oolite strata forming arable soils, whilst on its clays are grown a variety of crops.

*Belgium* is an equivalent to South Wales, or to the Staffordshire district, its four southern provinces being constituted of rock of the carboniferous age, and presenting an association of coal, iron, and limestone, such as we have ascertained to prevail in the English areas now mentioned. The principal products of its mines are iron ore, blende, calamine, galena, and coal.

*Switzerland*, the mountain country *par excellence* of Europe, with its metamorphic rocks, might be inferred to present a repetition of the phenomena which obtain in North Wales; but it is otherwise, for these granitic and gneissic rocks are but metamorphosed oolitic and newer strata; and as we have shown that deposits of these formations are usually unproductive in minerals, Switzerland, if our generalisations are correct, can never be a mining country, and, from its mountainous character, it can only be a pastoral one.

*Saxony* presents, in its rock-masses and its mineral wealth, similar conditions to those which prevail in Devon and Cornwall.

*Norway*, from an agricultural point of view, is to Northern Europe what the Highlands of Scotland are to Great Britain; its rocks, however, contain some of the richest deposits of iron ore in the world.

The coal raised in the United Kingdom, compared with the iron extracted from the ore, is in the proportion, by weight, of about ten to one, with values nearly corresponding.

Of mineral produce coal stands pre-eminently first, both in quantity and value. The amount raised much exceeds a hundred millions of tons yearly, and is always tending to increase. Of the annual output nearly a tenth part is exported, France taking a larger share than any other country, while scarcely a civilised state in either hemisphere, or even an island, but draws upon our stores. German demands are large, though the Germans are trusting more and more to their own natural resources for coal. Italy, Spain, Russia, and Denmark rank next in order of importance as consumers of British coal, and even Belgium, though only second to Great Britain as a coal-producing country, nevertheless imports British coal. Our distant exports are largest to South America, the East Indies and the Cape, and are nearly approached by the supplies sent to the West Indies and North America. The gross value of British coal, compared with mineral produce of every other kind, is in the proportion of nearly two to one.

Taking the metals and economic minerals other than coal, iron assumes a precedence over the rest, like that of coal over our whole mineral produce. At a great distance in the rear, but next to iron, in weight and value, comes lead, followed closely by salt, copper, tin, and clays (fine and fire clays), together with various earthy minerals of economic value, zinc, and numerous minor ores.

The following table exhibits the series of formations composing the stratified rocks of England :—

| Epochs or Periods. | Systems. | Formations. |
|---|---|---|
| Tertiary or Cainozoic. | *Pliocene* . . . | Post-Pliocene. Newer Pliocene. Older Pliocene. |
| | *Miocene.* | —— |
| | *Eocene* . . . | Upper Eocene. Middle Eocene. Lower Eocene. |
| Secondary or Mesozoic. | *Cretaceous* . . . | Chalk. Upper Greensand. Gault. Neocomian. Wealden. |
| | *Jurassic* . . . | Purbeck. Portlandian. Kimmeridge Clay. Coral Rag. Oxford Clay. Cornbrash. Great Oolite. Inferior Oolite. Lias. |
| | *Triassic or New Red Sandstone* . . | Keuper. Muschelkalk (absent in England). Bunter. |
| Primary or Palæozoic. | *Permian.* | —— |
| | *Carboniferous* . . | Coal Measures. Millstone Grit. Mountain Limestone. |
| | *Devonian and Old Red Sandstone.* | —— |
| | *Silurian* . . . | Upper Silurian. Middle Silurian. Lower Silurian. Primordial Silurian. |
| | *Cambrian.* | —— |
| | *Laurentian.* | —— |

## CHAPTER IV.

### THE UNITED KINGDOM: IRELAND—RAW PRODUCE, MINERAL, ANIMAL, VEGETABLE.

Relation between Raw Produce and Industry—Geological Conditions of Mineral Produce—Application of Principles to Ireland—Ireland not noted for Minerals—Pre-eminently Pastoral—Vegetable Produce—Natural Advantages of Ireland—European Analogues.

THE industrial occupations of the people of the United Kingdom have been proved in the preceding pages to be the result of natural laws, and not of chance. The seats of mining and of manufactures are determined by the local mineral deposits, and the importance of the one is proportionate to the richness of the other—especially so in relation to iron and coal. Given the geological character of the rocks and soil, with the physical distinctions of highland, lowland, plain and marsh, and the climatic phenomena, we may infer much of the raw produce, organic and inorganic.

The mountain borders of Ireland give occupation to labourers in mines and quarries, and copper and lead are produced in the counties of Wicklow, Cork, and Waterford. Iron is more widely dispersed, but, for want of coal, is unprofitable to smelt. Peat is almost the only fuel. Limestone is the principal rock of the interior; statuary marble of fine quality is met with in Galway, Kilkenny, and Donegal, and granite in many parts. Nevertheless, Ireland is not noted for useful minerals. The special physical feature is the dreary expanse of bog, occupying 3,000,000 acres, or a tenth of the

central plain of the kingdom. The great bog of Allen, once a forest, spreads through four counties. These bogs are considerably above the level of the sea, and sometimes of considerable thickness. They lie upon vast deposits of clay and drift, which overspread the Mountain Limestone, and, in steep impervious embankments, form the confines of stagnant reservoirs of saturated vegetable soil, unsafe in places for the smallest quadruped to walk upon. The structure of the bogs indicates the proper method of drainage; but notwithstanding a river system unusually complete, little has been reclaimed, and since bog earth is deficient in mineral constituents, it is doubtful if drainage would ever repay, in produce, the cost of reclamation. Ireland is eminently pastoral, and there appears no limit to its dairy and grazing capabilities. Pastures cover two-thirds of the country, and four-fifths of the people depend upon field labour. As a rule, however, the farming is inferior, the tillage slovenly, and the implements rude. The production of butter and provisions for export is, nevertheless, prodigious. Salt beef, pork, bacon, lard, and many millions of eggs, are consigned to England. Cork has, virtually, the victualling of our navy. Waterford despatches abroad enormous quantities of butter yearly, and slaughters every week many thousand swine, while the quays, a mile long, constantly swarm with live stock for embarkation.

The eastern provinces are more flourishing than the western. The Curragh of Kildare competes with the English downs as a grazing-ground, and sheep have fed for ages upon its sweet herbage. In the open country corn intervenes between the breadths of potato, and meal and milk are used for food. The fields smile with the blue-flowered flax, which the cotters grow for their families and weave in the hand-loom. The people of these districts are of English or Scotch descent, and have carried their native

skill and thrift into the country of their adoption. They command, therefore, higher wages, and can pay higher rents for less propitious soil, than the native Erse.

Ireland's resources are, to a great extent, still undeveloped. With a coast-line of 2000 miles, and inlets penetrating the land from opposite coasts, with a matchless system of rivers and lakes, the surface resembles a dissected map, every dividing line being a means of production or a facility for trade. The ill-fated Lord Strafford, more than 200 years ago, saw how well the flatness of the country and the slow flow of the rivers suited inland communication, and he devised a great scheme of intersecting canals even now but partially carried out.

Of recent years oats have come to be the crop most extensively grown, while the cultivation of wheat has so increased as sometimes to leave a surplus for exportation; nevertheless, the humidity of Ireland will ever render the harvests capricious. The native sheep was covered with a coarse hair, but by intermixture with English breeds is now improved. The production of wool is valuable and abundant, but the manufacture is confined to coarse goods, and carried on with insufficient capital. For cattle-rearing and dairy produce, Ireland might be matchless. Her only European rivals are Denmark and the Netherlands, where the prevalence of water shrouds the plains with vapours, which clear away before the summer winds, to reveal meadows covered with kine. The quays and jetties of the Hanse Towns and the Dutch ports resemble those of Cork and Waterford, swarming with stock, and filled to repletion with cheese and "provisions." While Ireland has languished, however, and a third of her inhabitants has disappeared, Denmark and the Netherlands, with disadvantages from which Ireland has never suffered, have grown prosperous and opulent.

# CHAPTER V.

## UNITED KINGDOM: GREAT BRITAIN—RAW PRODUCE. MINERAL, VEGETABLE, ANIMAL.

General Description—Relation between Industrial and Geological Features—Mineral Produce of England and Scotland contrasted—British Mineral Produce compared with European—Animal Produce: Domestic Animals of Great Britain—Vegetable Produce: Food Substances for Man and Animals.

ENGLAND is more a mining and manufacturing than an agricultural country, although the mineral region occupies but a third of the surface. The mining and manufacturing industries of Scotland assume larger proportions, with a still more confined space for their operation. The chief mineral products of Scotland, as of England, are coal and iron, the beds of which, together with limestone and sandstone, cover nearly a thousand square miles lying south of a line joining the estuaries of the Clyde and the Tay—the most populous, wealthy, and busy part of the kingdom. Rich mines of lead, with which a small quantity of silver is intermixed, are worked in the Lowther Hills. The Highlands are deficient in metals. The Grampians, especially, are as destitute of ores as their summits are of vegetation. The recent discoveries of gold in Sutherlandshire have up to the present not developed, to any extent, a new industry in this impoverished county.

The most important quarries of granite are those of Kirkcudbright, Peterhead, and Aberdeen. Whole towns in

Scotland are granite-built, and with improvements in the machinery for cutting and preparing this stone, its use has greatly extended in England. Many of the new buildings which adorn London are decorated with polished shafts and columns of coloured granite. Its great weight prevents its more general adoption for monumental and national designs.

Roofing-slates, also, are extensively quarried in a few parts of Scotland; and valuable building materials are supplied by the sandstones of the Old Red and Carboniferous systems.

Oolite is quarried in Gloucestershire, Somersetshire, and Portland. The city of Bath, St. Paul's Cathedral, Somerset House, and many London churches, show with what favour it is regarded for building. Lime is made from the chalk that stretches from the South Downs to Flambro' Head. Fuller's-earth is dug at Reigate; and millions of bricks, for railways, sewers, and buildings, are made from the London and other clays.

Cornwall is almost purely a mining region, having scarcely any manufactures and very limited agriculture. Its commerce and shipbuilding are comprised within small bounds; but it has an apparently exhaustless supply of tin and copper, rendering the county of great interest and importance.

The South Wales coal-field is the parent of several industries. Besides the smelting of copper from Cornwall, Ireland, Chili, and elsewhere, and its production of fuel, it is a seat of the iron manufacture; Merthyr Tydvil and Cardiff being the most important towns thus engaged. Swansea is the centre of the copper-smelting. Our other coal-fields, with one exception, are also productive of iron-stone, and originate the characteristic pictures of the "Black Country" covering the Dudley coal-field, and of the con-

geries of iron-works, collieries, and factories which give to South Lancashire the aspect of one densely-populated town. The celebrated coal-field of Northumberland is deficient in iron-stone, although the neighbourhood of Hexham produces iron of very fine quality.

The wonderful supply of coal and iron casts every other mineral into the shade, else Great Britain would be called rich in lead, zinc, and the minor metals. The precious metals are rare, and seldom worth the working. Burât has computed that the production of the useful metals and coal in Great Britain is four times that of France and Russia, six times that of Austria, eight times that of Spain or Scandinavia, nine times that of Prussia, and eleven times that of Belgium. What is the result? The metal and coal of Great Britain, transformed into machines, are computed to equal in productive power the hand-labour of every human being living. It is as if the population of a second world were contributing to lessen the toil of the thirty millions in this small corner of Europe. Manchester and Liverpool were small towns till machinery made our gigantic cotton industry possible. The imports of raw cotton have exceeded a thousand millions of pounds yearly, and are rapidly returning to that amount.

Eastward of a line drawn between the Tees and Exe, the surface exhibits fertile plains, varied by rivers, valleys, and green undulations, by a few wild and sterile heaths, and in the north by bogs. The Bedford level and the Lincolnshire fens are the principal marshes. The soils, like the rocks upon which they lie, are not distinguished by their extent so much as by their variety. Clay, loam, sand, chalk, gravel, peat, are all represented, simply, and in many forms of combination, and impress distinctive characters upon an indefinite number of districts. The largest tracts of uniform soil are in Norfolk and the wealds of Kent

and Sussex. Surrey has, for its size, more extensive tracts of sand and gravel than any other county, of which the heaths—Bagshot, Wimbledon, Weybridge, Woking—and the suburban commons of London are illustrations. Few of the plains are quite barren, and none of the sandy tracts are so large as the Landes of France. South of the wealds, from Beachy Head to Salisbury Plain, runs a low line of chalk downs, with a velvet pile of herbage, trodden and cropped by sheep of the finest breeds, famous both for flesh and wool. Kent is the garden of England. The trailing hops of Canterbury and Farnham vie with the vineyards of France, and the hop-picking recalls the animation of the vintage. Between Sussex and the Wash, wide tracts wave with corn. Barley for malting is a great object of culture in the same tracts and in the midland counties, while oats grow chiefly in the fens and in the north. Potatoes thrive in Leicestershire and Cheshire, and the turnip tribe has spread from Norfolk all over the kingdom. Pulse grows everywhere. Flax and coarse hemp of excellent quality are cultivated, though the quantity is small.

The husbandry of Scotland ranks very high even within the mineral lines, but the soil capable of tillage is limited. Comparing one kingdom with another, England has half its surface in pasture, a third under tillage, and a sixth in wastes, towns, roads, and waterways; while Scotland has only one-fourth under cultivation, with three-fourths in wastes and ways. For the operations of husbandry a granitic district offers few facilities: the bare pinnacles weather slowly, and form too scanty a soil for cultivation. The Grampians are naked and sterile, as are also the broken islands of the north; while large counties, such as Sutherland, can only be laid out in sheep-walks. The most fertile parts of Scotland are the tracts between Perth and Dundee, Teviotdale, Fife, the Lothians and Tweedside.

From climatic causes the Scotch crops arrive at less perfection than they do in England; the solar heat is inconstant, and, as in Ireland, often insufficient to ripen grain and secure harvest. Barley of the same weight as English barley contains less sugar and does not malt well. Various fruits which ripen in the one division seldom mature in the other and never become so choice; but different berries acquire in Scotland somewhat of the delicious flavour which distinguishes them in still higher parallels of latitude.

Owing to the broken nature of the Welsh counties, sheep and cattle are pastured upon the hills, which, unlike those of the Scottish Highlands, are covered with grass to their summits, and tillage and dairy work are carried on in the valleys. Welsh sheep are small, but the mutton is renowned for the delicacy of its flavour.

In addition to food products, the special objects of British husbandry are barley and hops for beer, cider apples, and flax, but none assume the importance of the vine in France, or of flax in Holland.

## *ANIMAL PRODUCE: DOMESTIC ANIMALS OF GREAT BRITAIN.*

**Horses.**—Hunting and racing are national sports. The English racer, improved with the best Arab blood, has become a type of the highest equine development. Yorkshire and Northamptonshire draught or dray horses, such as are used by the London brewers, are unrivalled in size and strength. The Suffolk Punch for ploughing, and the old Lincolnshire cart-horse, have long been eminent. The twelve sable steeds used to draw the state car at the funeral of the Duke of Wellington (in 1852) were a part of the trade stud of a distiller.

**Cattle.**—Our domestic cattle, like our horses, are

among the finest in the world, although their number is insufficient to meet the home consumption. The Devonshire oxen, and the breeds of Gloucester, Hereford, and Sussex are as famous for muscular power as they are for fattening. Comely cows and finely-proportioned steers are the pride of English estates, and breeders compete for honour as well as for profit. The animals of the greatest bulk are those of Lincoln and Tweedside. The latter are of historical note, for during the long period of border warfare, the lifting of cattle, and the levying of black-mail were not merely incidents of quarrel, but also frequent incentives. In our days, Scotch kine are transported to the rich southern pastures to fatten for market. Dairy produce must not be undervalued, for milk is consumed by young and old, and its secondary products, butter and cheese, enter more largely into the constituents of the food of every family than any substance except bread. The localities most favoured for dairy produce are referred to below.

**Sheep.**—Lincolnshire, Norfolk, Sussex, Wiltshire, and the Cheviots have given names to famous breeds of sheep, and, taking into account the fleece as well as the flesh, no foreign ones are their equals. By skilful crossing, the maximum of meat and wool of the best quality has been combined in the same animal.

**Swine.**—Berkshire, Gloucestershire, and Sussex have given names to breeds of pigs. The fame of Wiltshire bacon, York hams, and Berwick pork suggests a widespread attention to these animals. Indeed, any British farm would hardly be complete without a well-filled sty or hog-pen. Turned into the woods in autumn, swine will feed greedily upon acorns, beech mast, chestnuts, and other dry indehiscent fruit, without attacking and destroying the young trees.

**Poultry.**—Amongst the minor produce of the farm,

poultry, headed by the common domestic fowl, stand highest. Turkeys and geese, at certain seasons, are fattened and brought to market in enormous numbers, providing us with an important supply of food.

**Wild Animals.**—The wild animals of Great Britain do not differ from those of Europe, and require but a brief reference. The bear, wolf, boar, fox, and wild ox once dwelt in the forests, and the beaver built on the river-banks. All but the fox and the ox have long since been extirpated. Wild oxen, unique types of our domestic breeds, are preserved with exclusive care in the spacious parks of Chartley, in Derbyshire, and Chillingham, the seat of Earl Tankerville, in Northumberland. They are smaller than the common ox, cream white in colour, with the exception of the ears, which are red, and the muzzle, which is black. Permitted to range at will through spacious parks, they retain many of the wild habits of their race. The fox has received the doubtful privilege of being preserved for the chase. On the borders of Cornwall, a few stags are still found in their natural state, and more exist in the mountains and the wooded parts of Scotland, especially in the forest of Athol. The roebuck, which seeks the hills only, is also occasionally met with there. The fallow-deer of our parks are of foreign introduction, but have taken so well to the climate that the French imperial parks have been stocked from England. By a severe system of preserving (a relic of ancient forest laws), hares, partridges, and in the north, red grouse, continue abundant, despite the progress of agriculture and the extension of towns. Water-fowl frequent the fens, the most numerous being congeners of the wild duck, and sea-birds make the northern cliffs their home. The rivers of Britain contain fresh-water fish, the delight of anglers, but, with the exception of the salmon, little regarded as a source of food. The Welland and the

Witham are at times so alive with the tiny stickleback, that farmers use the fish for manure.

## *VEGETABLE PRODUCE: FOOD SUBSTANCES FOR MAN AND ANIMALS.*

Of the substances grown for the food of man, corn stands first; and of the different kinds, wheat is so pre-eminent in importance that the value of this crop nearly equals that of all the others. Reading, Guildford, and Uxbridge are the local markets for the finest white wheats, produced in the fertile fields forming the basin of the Thames; the south-eastern counties find their market for the same sort in London. The district between the estuaries of the Wash and the Thames is equally renowned for the growth of red wheat, a variety of inferior value, but greater yield. Wheat does not ripen at the sea-level further north than the line of lochs running from Loche Linnhe to the Moray Firth. Next to corn, green vegetables form the chief supply of food for all classes, the great towns being surrounded on all sides with productive market-gardens.

**Food crops for animals** form an essential part of the industry of the husbandman, and consist of both grasses and roots. The grass, oats, and hay of England are of great excellence. A few weeks' feed in the alluvial marshes of the Thames restores imported foreign cattle from the effects of the roughest voyage, covers them with flesh, and fits them for the shambles. The root crops are either eaten down in the open field, or stored for winter food.

**Fruits.**—Of fruit-trees the species are not numerous, though the varieties of each species are endless. The apple is cultivated as a wholesome article of food, as a dessert fruit, and for cider. This fruit abounds in every part of the kingdom, but the region of the west and south-west of England is the cider district.

The pear stands next in value to the apple, flourishing under similar conditions of climate and soil, and furnishing a beverage called perry, chiefly made in Worcestershire.

Our orchards and gardens are enriched still further with drupes, or fruits of the almond tribe, as the plum, the apricot, and the cherry. The produce of the garden also includes gooseberries, currants, strawberries, and other small fruits, culinary vegetables, and sweet herbs. Some of these were brought from Holland in the reign of Henry VII. The indigenous fruits are very few, and limited, probably, to the crab apple, the wild cherry, the bird cherry, the sloe, the haw, the bramble, the gooseberry, the cranberry, species of bilberry, and the raspberry.

**Timber.**—England has always been famed for her forests, which neither the enormous demand for ship and house building, nor the exigencies of farming, have yet caused entirely to disappear. Most of the European exogens valued for their timber are found in England. Our largest forests are Crown property, and still grow oak for the navy. Such are the New Forest, covering 400 square miles; the Forest of Dean, in Gloucestershire, of 144 square miles, and others of smaller area. Many localities of historical note have long been disafforested, or thrown open to common use. Norwood and Charnwood, for example, are forests only in name. Science has lent the aid of iron as a partial substitute for wood, besides which we annually supplement our native stores by many million loads of timber from British possessions and foreign parts.

The mountains and islands of Scotland are singularly treeless and bare. There are, however, a few extensive growths of fir, particularly in Aberdeenshire. The landed proprietors have of late years beautified their estates with larches, carrying out the behest of the Laird of Dumbiedykes, "Jock, when ye hae naething else to do, ye may be aye sticking in a tree; it will be growing, Jock, when ye are sleeping."

The chief kinds of British timber trees are the oak, the beech, the chestnut, the elm, and the ash. In the south, the elm, poplar, and birch are specially numerous. The ash and the Scotch firs are indigenous to the northernmost parts of the islands.

Great Britain contrasts with Ireland in the occupations of its inhabitants, a larger percentage being engaged in mining, manufactures, and commerce than in the varied pursuits of agriculture. Of the three divisions of Great Britain, only Wales shows a larger percentage of its population employed in agriculture than in other forms of industry; though here also the mineral counties are the wealthiest and most populous. To the end of the eighteenth century the people of England and Scotland were more engaged in agriculture than in mining and manufacture; but the development of mineral wealth has since been so great as to transpose the respective industries, and the tendency is, at the present time, still more rapidly in the same direction.

DISTRICTS OF ARABLE HUSBANDRY.

ENGLAND.—Kent, Essex, Suffolk, Norfolk, Hampshire, Berkshire, Bedford, Surrey, Sussex, Hertford, parts of Yorkshire and Lincolnshire, Durham, and Northumberland.

SCOTLAND.—The Lothians, Berwick, and part of Roxburgh, Dumfries, Ayr, Renfrew, Lanark, and Fife shires, Carse of Gowrie, parts of Aberdeen, Elgin, and Nairn.

DISTRICTS OF DAIRY HUSBANDRY.

ENGLAND.—Cheshire, Shropshire, Gloucester, Wiltshire, Buckingham, Essex, York, Derby, Cambridge, Dorset, and Devon.

PASTORAL AND CATTLE REARING DISTRICTS.

Lincoln, Somerset, Leicester, Northampton, Herefordshire, parts of Durham and of the North and East Ridings of Yorkshire, and the Downs.

PERCENTAGE OF INHABITANTS ENGAGED IN AGRICULTURE.

Lincolnshire, 16 per cent.; other districts as above, 10 per cent. to 14 per cent.; Middlesex, 1 per cent.

## CHAPTER VI.

### BRITISH FISHERIES.

Condition of British Fisheries—Staple Fishery—Salmon Fishery—Shell Fish—Whale Fishery.

BRITISH seas are rich in food produce; relatively, however, to other industries, the fisheries have, until recent years, been languidly pursued. At one time it was thought necessary to pay bounties—a system adopted before the regular navy was established. The seamen under Drake, Hawkins, and Frobisher, having signed to serve when called upon, were drawn principally from the fishing stations. Bounties and grants were advocated afterwards for the sole purpose of encouraging the fishing interests.

Public opinion has greatly changed with respect to any such artificial stimulus to industry. Royal Commissions have made inquiries, and Government has decided that the prosperity of our fisheries depends, in the long run, upon native enterprise and energy. Meanwhile the food question has grown to be of urgent national importance, and Fishery Exhibitions have made the fisher-folk and their "perilous mode of hard industry" better known and more popular. Although tenfold the present take would find ready consumers, even now, through the excellence of our communications, fish food is almost as easy to obtain in inland villages as in the fishing ports.

The staple fishery of the United Kingdom is that of

herrings, shoals of which, at the season of spawning, crowd the inlets and bays of Great Britain and Ireland. Of the English fishing stations Yarmouth possesses the greatest celebrity for its semi-smoked and salted bloaters, everywhere esteemed. From Yarmouth to the Shetlands, fleets of herring-boats ply their nets, every town on the coast being more or less employed in the capture and curing of this important fish. The Scotch herrings are larger and higher-dried than those of Yarmouth. The chief fishing-station, probably, in the United Kingdom is Wick, within a few miles of John o' Groat's. Peterhead and Fraserburgh are likewise places of great resort for curing herrings; while the poor and simple Shetlanders have, in one generation, made their distant islands one of the great fishing stations of the world. The Scottish fisheries generally are prosecuted with energy in every firth and loch, as well as in the channels of the northern and western islands. The Irish fisheries, on the other hand, have thriven least. Some of the most considerable are on the Nymph Bank, south of Waterford, but the produce is principally taken to English ports.

Pilchards, allied to the herring, are seasonable from early June to October. They are found in all the creeks of Ireland, and off the coasts of Devon and Cornwall. These fisheries fall but little short of the importance of that of Yarmouth; yet while herrings are the frequent frugal meal of the London poor, pilchards are hardly known to them, and are only seen when a few stray catches are used as prize sprats to embellish the fishmongers' silvery heaps. Many thousand hogsheads of pilchards are exported to the Mediterranean, whence we get the closely-related anchovy and sardine, the interchange adding to the variety of food on both sides. Sprats are found in enormous shoals during the winter months, and are often wasted for want of a ready market.

Between the Cornish and Yarmouth fishing-grounds mackerel intervene, extending mainly from the Isle of Wight to the Straits of Dover, and assuming during the season a very considerable value. From Ireland large supplies of remarkably fine mackerel have lately been received, packed in ice.

Turbot, soles, and other so-called flat fish, as well as cod, abound on the sandbanks of the North Sea, especially the central Great Dogger Bank. Here fishing-boats are now stationed for weeks together, and the produce of the nets is forwarded to London and elsewhere as fast as swift-sailing cutters or large screw steamers can carry it. By this means many additional hundreds of tons of fine fish, especially plaice and haddocks, are obtained for the poorer population of our large towns. There are extensive cod and white-fish fisheries in Scotland. The fishing-grounds round Ireland abound with cod, hake, and ling, but have never yet been satisfactorily worked.

The salmon originates a peculiar fishery, in which again the Scotch are foremost. The rivers Tweed, Tay, Dee, Don, and Spey teem with this noblest of the finny tribes, whose capture is a fluctuating but very valuable division of industry, and an attraction to anglers from the most distant parts of the kingdom. The Irish rivers glisten with salmon, which, however, until lately, were not sufficiently cared for, from an economic point of view.

A trade in salted cod, wet and dry, is carried on with St. John's, Newfoundland, the headquarters of the British fisheries on the Great Bank, where the fish taken into St. John's for exportation are chiefly caught.

**Shell Fish.**

Shell-fish, as various forms of crustaceans and molluscs are called, provide us with a large amount of food. There

is a lobster fishery along the rocky coast of Yorkshire, another in the Orkneys, and thousands of lobsters and crabs are caught yearly on the south and west coasts of England, to be sent to the London markets. Ireland supplies us occasionally with large quantities of lobsters, but we procure our finest from Norway, where they are carefully preserved. In the opinion of naturalists we might quadruple at least the produce of our own shores.

Prawns are "potted" on the south coasts, and shrimps are netted on most shallow shores; Boston, Lynn, and Leigh, near Southend, supply the choicest kinds. One eminent firm alone pays from £800 to £1000 a year carriage for this tea-table luxury. The greatest quantities are obtained from the Briel, *viâ* Harwich; these are the *red* shrimps of the trade.

All round the coasts of these islands are spots noted for oyster culture. The finest variety is that of the Whitstable native. For some years past an increasing dearth in the supply, arising from climatic influences, or, as some think, from the destruction of the spat or young oysters, through careless dredging, has made the choicer sorts an indulgence only within the reach of the rich, and has directed the attention of the Government to the subject. The oyster occurs chiefly in estuaries, the Thames, the Wash, and the Severn all having extensive beds, as have likewise some of the estuaries of Ireland.

Great Britain has ever been the home of the oyster, and the race still attains its greatest perfection in our seas. Efforts have been made to bed exotic varieties in European waters to supply the British demand, and many inferior beds, likewise, have been dredged. America, too, where the dainty mollusc, cooked in fifty ways as well as served raw, appears at every meal, has sent us vast stores.

Great quantities of mussels aggregate on the rocks, attached

by their byssal threads, and serve for food in the towns near their growth, while still more are used as bait. Millions of mussels are gathered for these purposes annually in the Firth of Forth. London consumes vast quantities imported from Holland.

Periwinkles are eaten wherever they can be obtained. Among univalves, whelks, of which the "almonds" and "whites" rank in order of quality, are esteemed by the poorer classes, and with the pecten or scallop, and the cockle, constitute an important article of commerce.

**Whale Fishery.**—To call the whale a fish, and its chase a fishery, is in either case a misnomer; yet, industrially, there is a relation between the sea fisheries and the whale fisheries. The economic products derived from the *cetacea*, with which we may place as a trade alliance the *phocidæ*, or seal tribe, and some large fishes, are oils, seal-skins, furs, baleen or whalebone, spermaceti, ambergris, and ivory, derived from the walrus and narwhal. Tasmania now despatches the greatest number of vessels to the Southern Sea; Hull, in England, and Peterhead, in Scotland, are the chief ports identified with the whale fishery of the northern seas. Besides the whales proper, the herbivorous or browsing whales, *Dugong* and *Manatee*, are captured for their oil, which is regarded as equal to the best cod-liver oil. The chase of the shark, likewise, is not declined by the whalers, who find a ready market in the East for its fins, valued there, as the turtle with us, for soups.

## CHAPTER VII.

### EUROPEAN ANALOGUES OF GREAT BRITAIN.

Analogues of Mining Industry—Of Animal Produce—*Rationale* of our Corn Commerce.

SIMILAR geological and climatic conditions yield analogous results in the flora and fauna of a country, and in the industrial pursuits of populations. Such analogues have already been shown between the United Kingdom and many parts of Europe. We exchange little raw produce with the people of the Continent, but we fetch and carry for our neighbours the crude materials of other soils and climes, and make our country the emporium of trade. Let us illustrate this by a few examples.

### *ANALOGUES OF OUR MINING INDUSTRY.*

The departments of France, with scarce an exception contribute individually to the mineral wealth of the country and their mines produce the largest amount of iron next to England. The most productive mines are those of the provinces, whose geological structure ranges across the Channel, takes in the Norman islands, and is identical with the formations occupying the south-west of England and Wales. The Ardennes, again, are part of the rugged borders of Belgium, where iron mines are so numerous that, for its size, the country is richer than England. The region between the Sambre and the Meuse resembles the Stafford-

shire "Black Country;" Dudley and Wolverhampton find their counterparts in Liége and Namur. French coal is principally dispersed along the flanks of the rocks stretching from Brittany to Switzerland, which rocks, with the Alps, make the division between northern and southern Europe. Modern industry has caused the French coal-mines to be extensively worked, though the produce is not of the best quality. Belgium, within its narrow borders, possesses twice as many coal-mines as France. A great field, resting on Mountain Limestone, extends from Aix-la-Chapelle to Douai, forming basins, of which those of Charleroi and Liége are the most important. The coal mines of Liége have been worked for seven centuries without making a serious impression upon the deposits.

Germany, and Prussia especially, possesses coal and iron ores of all qualities in abundance; but the distance between the mineral beds and the limestone quarries, with heavy transit charges, impedes the development of iron industry.

Some of the rocky islands of Norway consist entirely of iron ore, and the finest quality produced is from Sweden. But here again carriage is so difficult as to render the metallic treasures of many districts in Scandinavia of but little avail. These difficulties, however, are now being overcome. Iron, copper, tin, and coal are dug in the Russian provinces near the Gulf of Finland, the largest works being situated on Lake Onega.

## *ANALOGUES OF ANIMAL PRODUCE.*

The sheep bred and reared in Saxony and Spain produce respectively a long silky fleece—the finest quality manufactured—and merino wool, a variety also of very high value, both of which enter into our manufactures. The alluvial plains of the Low Countries and Denmark are

the counterparts of Ireland. Enormous imports of cattle, butter, cheese, poultry, and eggs, from these parts, supplement our home supplies. For the first ten years after the foreign trade in cattle was made free, its development was very rapid, the rate reaching 400 per cent., which has since constantly increased. The proximity of the Dutch to the sea has made them the fishermen, and their country the fish-market, for nearly all Europe. Formerly they took most of the fish even off the British coast; and we still look to them for large supplies in answer to an indefinite demand for food at home.

Now it is self-evident that these countries do not require similar commodities from us in exchange, nor should we want their produce if we already possessed a surplus; but we send them manufactured goods, for the production of which they have not equal facilities; and we tranship to them the raw produce of our colonies and of foreign parts, which are wanted by the inhabitants of the civilised world generally.

## *THE ANALOGUES OF VEGETABLE PRODUCE.*

These have been already referred to. Southern Europe is eminently the region of oil and wine, with which the United Kingdom has but little in common. Adjoining this on the north is the zone of cider and beer, of which our country forms a portion. The designation of the region implies the common growth of orchard fruits, hops, and barley; but it is equally the region of green vegetables and wheat. Indeed, in all parts of Europe, excepting polar Russia, cereals furnish the chief supplies of food—viz., barley and oats in the north; rye in the next lower latitudes; then wheat, which penetrates into the districts of rice and maize, the true tropical cereals.

Our pre-eminence in wealth enables us to add to our abundance by purchasing the surplus stores of food of the whole zone. We receive great quantities of early fruits, flowers, roots, and vegetables from France and Portugal. We also obtain large supplies of fresh fruits, roots, and vegetables from the Channel Islands, Holland, and Spain. Since, too, the St. Gothard Tunnel has been opened, Malta and Italy have sent both their fruit and dairy produce in largely increased amounts; and even the distant Canaries contribute towards satisfying, in these directions, our vast demands. Wheat formerly came to us from France, where it is an important agricultural product.

The Sarmatian plain is the reserve granary of Europe: enough is here produced, even without manure, to feed the whole Continent; but the means of transit are so bad, that much good corn is left to rot upon the ground, and a considerable part takes two years in reaching a port for shipment.

The low lands of Prussia wave with great growths of wheat and other cereals, enabling its eminently agricultural people to provide for various unproductive provinces, and still to have an excess. Recent political alterations of territory have made the Prussian corn exports at least as valuable as those of Russia.

Enormous as is the produce of the United Kingdom, it is far below the demand for food for man and beast. Almost every part of the earth capable of growing corn sends grain to the British market; freights of wheat arrive in England from the United States, from the ports of the Baltic and the Black Sea, from Algiers, from the Danubian provinces, and from Turkey and Egypt—countries where an elastic growth expands or contracts in conformity with the demand. In Egypt, wheat is a winter crop. California, Australia, and India compete in the fineness and quantity

of their produce, and promise, ere long, to overshadow all other sources together of our grain supply. Our imports are influenced by the seasons causing fluctuations of value, and demanding from dealers much commercial shrewdness, vigilance, and foresight. If the home harvest promises abundance, our demand abroad is lessened, and farmers and merchants hasten to market to ensure sales; but if fears of scarcity arise, they withhold their stores, in the view of higher prices; and the harvests of other countries compete, till prices again are equalised.

The insight which farmers and merchants have gained from experience ministers to human well-being; for high prices warn us of probable dearth, and enforce economy, while low prices add to our enjoyment by removing any dread of the future. If the harvest fails, we are prepared with stores laid up by capitalists who have acted as scouts, and have well earned the extra profit gained by their forethought. If the harvest turns out unexpectedly good, our caution has done us no harm. The judgment exercised by the merchants must be measured by their profits, by which, therefore, they may, in the absence of any monopoly, be measured as benefactors to society. Yet, in former years, to speculate in corn was a crime, and "forestallers" and "regraters" were punishable by law.

## CHAPTER VIII.

### THE BRITISH EMPIRE: COLONIES AND POSSESSIONS.

General Description—The Colonies considered in their Climatic Zones —Dominion of Canada—Zone of Wheat and Northern Grains—Produce of the Warm Temperate Zones—Australia—South Africa —Indian Possessions—West Indies and Central America—Acclimation.

THESE descriptive examples of analogous produce between the United Kingdom and various European States show that our commerce would be very narrow if limited to Europe. But British produce, properly so called, is represented by our colonies and possessions in every part of the globe. Regarded in this light, it embraces nearly every known commodity, and explains our supremacy in commercial interchange. To arrive at a clear conception of so important a subject, it is necessary to possess a double knowledge, first of the range and nature of commodities included in the term British produce; secondly, of the conditions of their production. An acquaintance with geology will enable us to trace the economic history of the inorganic or mineral division of those commodities, while the aid of physical science is generally required to elucidate the more complex phenomena of organic or animal and vegetable produce.

Whether or not climatic influences originally affected the deposition of the useful minerals, we cannot discern

among them any present relation to zones of temperature. Minerals, metalliferous or otherwise, are grouped in certain formations at the pole, or at the equator. Gold is found in the frosty Urals, and in the sands of Africa; copper in Lapland and Australia; tin in Cornwall and in the Straits Settlements. While, therefore, our studies of organic nature, in forms of both animal and plant life, must be determined by geographical conditions, we must systematise our investigations of the mineral kingdom on purely geological principles.

## *THE COLONIES CONSIDERED IN THEIR CLIMATIC ZONES.*

The isothermal zones, or zones of equal temperature, correspond but very irregularly, and in parts not at all, with the parallels of latitude, being disturbed by every new combination of the elements of climate. The absence of land, for instance, causes the southern hemisphere to be cooler in summer than the northern hemisphere, while the equable climate of the ocean presents fewer marked deviations from parallel bands. The zones have been variously designated according to the prevailing character of their productions. Grain, being more widely spread and more largely produced than any other food substance, is the product most usually applied as a descriptive term. Equatorial grains are maize and rice, the latter of which is supposed to feed as many of the human family as all the rest of the cereals put together. Wheat blends with these grains in both hemispheres, first as a winter crop, and afterwards as a summer crop. Still farther from the equator, wheat grows along with rye, barley, and oats, the so-called northern grains, which extend into higher latitudes where wheat disappears.

The following approximate chart will now assist us :—

| Zone. | Approximate Latitudes. | Characteristics. |
|---|---|---|
| Tropical . . | 0° to 23.5° | Intense vitality, rice, maize, palms, spice, sugar. Carnivora. |
| Warm Temperate | 23.5 ,, 45 | Wheat and tropical grains. Olive, citron, grape, fig. Domestic animals. |
| Temperate . . | 45 ,, 55 | Wheat and northern grains. Orchard fruits. Forest trees. Domestic animals. |
| Sub-Arctic . . | 55 ,, 66.5 | Northern grains. Berries. Pines. Fur animals, bears, seals. |
| Arctic . . . | 66.5 ,, 90 | Mosses and lichens, saxifrage. Lowest vitality. |

### I. Arctic and Sub-Arctic Zones: British Colonies (Northern Grains).

The only parts of these zones under British rule are the great territories of North America, which, until lately, in the hands of the Hudson's Bay Company, and now forming part of the Dominion of Canada, have long been famous for their produce of furs, for which, indeed, the whole zone is the world's hunting ground. The marine produce of the region has been referred to in describing the British whale fisheries and the Newfoundland cod fisheries. The northern seas teem with life; but the types, if not the numbers, grow fewer as they approach the poles. One of the principal forms is that of the minute molluscs, the so-called "whales' food," which the leviathans engulf with open mouth and entrap in the fringes of their plates of baleen. There are no British possessions in the sub-arctic portion of the southern hemisphere; Cape Horn is the only point of mainland reaching 55°.

### II. Temperate Zone: Zone of Wheat and Northern Grains.

The climatic limits of this zone, in the northern hemisphere, are more irregular than the boundaries of the

warmer zones, being subjected to the variable physical influences which characterise the temperate regions. This irregularity is greatest amid the broken coasts of Europe, where the configuration of the land adds to the deflection caused by rains and winds not periodical, and by the Gulf Stream. It is, therefore, with an elastic meaning that we speak of the width of the zone in degrees. The zone is determined northward by the line where wheat ceases to ripen, and southwards by the limits of the ripening of the grape. The limit of wheat in Britain is at Inverness, in latitude 58°, whence it is deflected across the North Sea to Drontheim, in Norway, in latitude 64°, and waves onwards to St. Petersburg, in latitude 60°, whence, varying with every local circumstance of climate, it passes through the Old World to the coast opposite Saghalien, in latitude 48° or 50°. Westward the same line sweeps across America, from the low latitude of 45° in Nova Scotia, rising in a broad curve to 48° or 50° on the Pacific side of the continent. The climatic line of the vine cuts the Biscayan coast of France, in latitude 45°, whence it is deflected to Berlin, 52° 31′, and afterwards passes on through Europe and Asia, in a wave gently tending to the lower latitude of 40° north of Corea. The same line reaches its lowest latitude in America, which it traverses nearly coincident with the parallel of 36°.

This great girdle comprehends the European plain, and a vast but nearly unknown strip of Central Asia. Westward it takes in the northern states of the American Union, and the British Confederation, of which Canada is the centre.

The corresponding zone in the southern hemisphere has fewer irregularities; it tends slightly nearer to the equator, and its outer limits have not yet been defined. The extreme part of Australia barely enters the zone, which is best re-

presented by Tasmania and New Zealand; Patagonia, in South America, trending furthest towards the south pole, is the greatest tract of land within it. Except our own islands, no part of the northern zone of the Old World, from the Atlantic to the Pacific, belongs to us. Throughout this extensive region, while every country has its specialties both in climate and produce, there is a general resemblance — a unity in diversity — which extends to both hemispheres. The general aspect of the vegetation may differ in each country, and yet be constituted of plants closely allied. While describing, therefore, the produce of our colonies, we describe generally that of the whole climatic region.

The part of Europe comprised in this zone is either named the cider and beer region, the butter region (distinguishing it from the division of the oil and wine countries adjoining), the region of summer grain, or of deciduous trees. Such descriptions indicate the nature of the produce. Thus, butter associates itself with pastures and oxen, and with dairy produce.

Inferentially it leads us to the consideration of the domestic animals, both for burden and food—to hides and skins, and wool for clothing. We have already illustrated the production of these in our own country. Let us now cross the Atlantic, and survey the produce of Canada. The same commodities reappear, and form the chief bulk of the wealth of that confederation. Our largest supplies of timber and of forest products come from Canada; the quantity of wheat produced is almost incalculable; and of provisions there is an ever-increasing store. If we go to the antipodes, the resemblance is still more remarkable. What is the chief produce of New Zealand and South Australia? Timber, minerals, cereals, cattle, and wool. The difficulties of transit being now in a great measure overcome, a trans-

fusion of useful produce is practicable in the two hemispheres. And all this is British produce—the aggregate upon which is founded our commercial intercourse with other nations.

### III. Warm Temperate Zones: British Produce. Wheat and Tropical Grains. Olive, Citron, Fig, Grape. Domestic Animals.

The warm temperate zone is well defined, and displays interesting correspondences throughout its circuit. In the northern hemisphere it is the whole region between the line of vine culture and the tropic of Cancer; in the southern hemisphere, it is the band cut off by the tropic of Capricorn from the American, African, and Australian continents. Of these southern lands, Cape Colony, Natal, and Australia are British colonies. In the northern zone, the only parts belonging to us are the Mediterranean stations of Gibraltar, Malta, and Cyprus.

*Australia.*—Scarcely separated from the Indian archipelago, with its northern parts purely tropical, Australia exhibits a distinctive character, differing from the exuberant life of the East Indies as much as the English settlers now spreading over its surface differ from its aborigines. Indigenous elements of wealth on this continental island are few, though important. Gold mines have for a long while annually yielded many millions sterling, most of which has arrived in England. Copper also has been obtained from mines—probably the richest known. Economic plants and animals were few, till introduced by the colonists. The kangaroo was the largest quadruped; it has been displaced by the sheep, and is becoming extinct. Cattle, multiplied beyond enumeration, roam over the plains, and meat is exported to England. Of animal products, the chief is wool of excellent quality and unlimited quantity, the supply becoming

gradually our mainstay for home manufacture. Tallow is obtained by boiling down the sheep, the perishable nature of their flesh giving them hitherto only nominal value as food. Salted or wet hides are exported in large numbers by the colonists, who have lately also prosecuted with great activity the sperm whale and South Sea fisheries. Like all the English race, they have a strong predilection for tea, which has made them attempt its cultivation, and with such promise of success that they begin to export part of their produce. Above all, Australia is successfully striving to become the world's granary for wheat; and to utilise her grand surplus of flesh-foods, for export to the mother country.

*South Africa.*—South Africa resembles, in its economic aspects, the corresponding latitudes of Australia. The two are our great sources of supply for wool. From both we obtain hides and skins in large numbers. The Cape farmers, by cultivating the vine, have made wine one of their exports, and Australia emulates the example. Ivory is another of the commercial products of the Cape.

### IV. Tropical Zone: British Produce. Rice, Maize; Palms; Spice; Sugar. Intense Vitality. Carnivora.

In the torrid parts of Africa there are settlements important commercially, if not in extent. Sierra Leone and the Guinea coast are names of fatal import, from the deadly pestilence which their valuable produce tempts the merchant to brave. Gold, hides, ivory, wax, teak, dye-woods, and palm-oil form the staples of production in these settlements.

Off the opposite coast of Africa, the Mauritius represents the tropics in its chief produce—that of sugar—to which it adds the allied commodities of molasses and rum.

*Indian Possessions.*—Far larger than our African pos-

sessions in our Indian empire, comprising India, Ceylon, Burmah, and the Straits Settlements, of which Singapore is the seat of government, not under the India but Colonial Office. Hindostan is so large that our other Indian possessions are in danger of being overlooked, although their produce is of the highest importance. And the corresponding Indies of the New World, including the Bermudas and Belize, are of no mean consideration. By inference we know that these countries will produce the raw materials of the zone in which they are situated, whether animal or vegetable; and only in the case of minerals will there be any great divergence. Viewing, then, the tropics generally, we see life in its intensest phase. Not only are individuals numerous, but species have greatly increased in number. Amongst animals, the carnivora reach their highest development. Flowers exhibit the brightest colours, and secrete the strongest essences; whilst the buds, blossoms, leaves, root, bark, and wood yield the pungent aroma of spices, with narcotic principles, and dyes, such as only arrive at perfection under the rays of a vertical sun.

*India and Burmah* typify the whole girdle of the tropics in the variety, exuberance, and value of its raw produce, which almost equals half that of the other British possessions combined. Of food substances it produces immense quantities in the forms of rice, sugar, coffee, and spices. Of materials for clothing, wool and silk of valuable qualities are produced; the Cashmere shawls made from the former being unsurpassed for softness and beauty by the products of our best looms. Vegetable fibres find India their most prolific home. Cotton has been an Indian commodity from the most ancient times. It was our sheet-anchor, and saved our staple industry from wreck when the war-storm passed over America. Kips or small dry hides from wild cattle of the interior are produced extensively, differing

from the hides of Australia and South America, which are larger and salted, and thus receive the name of wet hides. Indigo and numerous dyes; opium, and many other drugs; tanning substances; gums, resins, and balsams; teak oak for ships; timber for building; cocoa-nut oil; and a thousand miscellaneous commodities reach perfection in this region.

*Ceylon.*—Ceylon varies somewhat, from the prominence which cinnamon and oil take amongst the raw produce, and in the much smaller cultivation of rice. It is the chief home of the cocoa-nut palm, as Arabia is of the date; and coffee is a staple product. Ivory is a valuable product of the island; and the pearls are of great renown, although new Australian grounds promise to vie with this famous fishery.

*Straits Settlements or East India Islands.*—The pepper vine, nutmeg, and clove are indigenous to the Straits Settlements—the botanical centre of spice-producing and aromatic plants. The chief spice islands belong to the Dutch, who once maintained the strictest monopoly of the produce. Birds swallowed the seeds, and, in spite of Dutch laws to the contrary, took them to the other islands, thus breaking down the exclusiveness. Dutch growers at length adopted the wiser policy of a free interchange of economic plants. Though now raised elsewhere their excellence is deteriorated, for these spices, like tea, are examples of plants that perfect their powers within limited areas.

Sago and tapioca are largely cultivated, especially the first, the plantations being furnished with the latest European machinery for their preparation. Other tropical substances are produced, some of them unique, such as the hydrocarbons, caoutchouc and guttapercha. Sumatra is a chief source of the fixed volatile oil known as camphor, and Siam of the yellow resinous pigment gamboge. Both of these

substances occur in trade as "tears" or solid masses, as well as "extracts;" and amongst other important properties, are useful as drugs. The dense jet-like ebony prevails widely, and forests of teak oak abound for shipbuilding.

Minerals are richly spread over the whole archipelago. Diamonds are obtained from Borneo, and gold from all the larger islands. Banca possesses tin mines as rich as those of Cornwall, and as easily worked, the ore being near the surface.

*West Indian Possessions and Central America.*—From the West Indies and Central America we obtain sugar, rum, coffee, indiarubber, tobacco, and cigars, of which last those from Cuba are accounted the finest; mahogany, and other timbers; dye-woods, as fustic, logwood, Nicaragua wood. Many of these products are equally the growth of Guiana, in tropical South America, from whose exuberant vegetation we obtain the cacao, or cocoa, of which chocolate is made; fruits, tapioca, Peruvian or Jesuit's bark: together with representative forms of the flora of the East.

The similarity of produce throughout the tropics cannot fail to be observed. The natural dispersion of plants and animals, and the transference and diffusion of species by human agency, as well as by the winds and marine currents, have increased the area of growth almost without limit; have made the good harvests of one country compensate for failures elsewhere; have added to the stores of food and clothing, and other necessaries; and, by so much, have added to human life and happiness. These results have rewarded human industry and intelligence ten thousandfold, and they ought to encourage us to extend the sphere of knowledge to its widest bounds.

While indicating the distinctive features of these climatic zones, we are impressed with the working of that law of nature which governs the prevalence of life. From the

Poles to the Equator, through every degree of latitude, life increases in energy, and assumes greater diversity of forms. Under a torrid sun is seen the intensest development of vitality and the greatest exuberance of types. Each zone in turn contains representatives of the flora and fauna of higher latitudes, and new types of its own. Thus while endogens are characteristic of the Tropics, yet forest trees abound of greater magnitude than those growing further north or further south. Those regions, too, develop a great variety of the finest fruits. Our European fruits are, indeed, in a great measure, acclimatised or rather acclimated exotics. By this is meant, not that the plant is forced into new conditions, but that a plant has certain degrees or limits, above or below which it will not grow or will not come to perfection. Acclimation finds out what these degrees are, or whether a modification of the conditions will bring about a useful modification of the plant itself.

In like manner the domestic animals of the torrid parts are exceedingly numerous and, in the case of the birds, are the source whence we derive both the common poultry of our cottages and farms, and the pheasant of the copse.

## CHAPTER IX.

### FOREIGN PRODUCE: EUROPE.

Interchange of Surplus Produce with European Countries nearest to England—The Vine—Wheat—Productions of Spain and Portugal—Mediterranean Sea-board—France—Italy—Danubian Regions—Zone of Northern Grains—Gradations in Fauna and Flora.

In our survey of the raw produce of the British Empire we have gained a knowledge, not only of the great variety and abundance of natural substances necessary to our well-being, but also of the surplus which we can offer to other countries in exchange for their productions, so as to add to our wealth. To understand the nature of these productions we must learn something again of the countries that produce them. It will be convenient to study such countries in the zones of climate to which they belong. Incidentally we have already done this, inasmuch as the detached parts of the British empire are dispersed through every zone. We have seen that organic products spread from certain centres, according to their natural powers of selection, as well as by human agency; and that they either extend their bounds to the utmost limits of the zone of their growth, or, crushed by stronger types of life, they die out, thus illustrating the law of the "survival of the fittest." In assigning to every organic product its own climatic region, where alone it reaches the highest excellence, Nature has made interchange a necessity.

Next to the produce of the British Empire, we are interested in the produce of the countries nearest to us,

for it is with these countries that the system of interchange begins.

## EUROPE.

Three climatic zones are well defined in Europe: they are the warm temperate, the temperate, and the boreal. Each of these zones is disturbed by local deviations, produced by the mountains and other physical causes, and is divisible into sub-zones of produce, with outlines less clearly marked. Southern Europe is bounded by the Mediterranean, into which sea mountain-spurs trend southward, the lateral outspread of which forms the peninsulas of the Morea, Italy, and the insular line of Corsica and Sardinia. The inland boundary of this southern zone is the line of vine growth, which we have already referred to, sweeping across Europe south of the limits of 45° on the coast of the Bay of Biscay, and 55° on the northern coast of the Caspian Sea. The vine flourishes in every part of this region, which is distinguished by the name of the *Wine Countries.* Nevertheless, the subdivisions of this zone possess an individual character. An elevated ridge line, traceable from the cliffs of Brittany, across the extinct water-filled craters of Auvergne, to the Alps and thence onwards to the Carpathians, divides the sunny south from Northern Europe, and defends it from the boreal winds. Southern Europe is unique for beauty and fertility. Clear air gives an extensive view of the landscape, and the sun, pouring down its rays unarrested by vapour, draws from the fruitful ground the blended produce of the tropics and temperate zones. The southern parts of Spain, Italy, and Greece even trench upon the region of palms, which bear fruit in several places, but elsewhere only develop their regal crown of leaves. The slopes of Etna are girdled with bands of vegetation, exemplifying vertical zones of growth, from the

date-palm, cotton, sugar-cane, pine-apple and prickly pear at the base, through citrons and evergreens, and a wooded region of leaf-shedding forest-trees, that hybernate in winter, upwards to the stunted vegetation of colder lands, and sterility round the crater. In Naples the cotton plant divides the field with the hemp and flax, and the fig attains perfection almost alongside of the oak and fir. Between Naples and the Alpine ridge, in Switzerland, every diversity of the zone is encountered. South of the mountains the "*olive* swells with floods of oil," almost as bounteous as water, and as freely used; the few parts subject to local frosty winds, where it will not grow, being too unimportant to rank as exceptions. Minerva's tree, the first "symbol of peace, prayer, and kindness," is the representative plant of the sub-zone, though it is not indigenous but a native of South-West Asia; whereas the orange and peach, the grape, cherry, and fig were brought from Asia, and maize was a gift from the New World, in return for the European cereals and domestic cattle. The Alpine heights, in strong contrast with much of Italy, endure an arctic climate. The valleys alone can be called fertile, and there is elsewhere scarcely any soil. It is only as the resultant of many differences that we include the whole region in one climatic zone. The *facies* or physiognomy of the vegetation is complex. The vine and its attendant cereal, wheat, are distinctive throughout; but the almond, olive, fig, citron, and sweet chestnut, together with the cork oak, myrtle, and other evergreens, the almond, fig, and the lily tribe, are only common in the warmer parts.

*The Vine.*—Although the vine ranges as widely as wheat, it is for vintage-purposes of little avail farther north than 50°, going off beyond that into leaf, and running to waste on approaching the equator, where also wheat is no longer

profitably grown. The vine, like the annuals, requires a certain amount of heat to ripen its fruit, and bears a cold winter better than a cool summer. This heat may accumulate, in warm latitudes, between March and September; while in Scandinavia, where the whole operations of husbandry are completed in three months, and barley is sown and reaped in seven weeks, the necessary amount of heat rarely occurs. It is not by any means the line of mean annual heat, but the amount of seasonal heat, that fits or unfits plants for certain latitudes. Beyond its natural limits the fruit of the vine can only be extorted from the soil by labour and skill, while, in its own zone, "profusion is lavished on the ignorance of the vine-dressers of Italy, and on the indolence of Spain."

In France, the vine is pruned down to the size of a gooseberry bush, and the vineyards consequently lose interest in the landscape; but in Italy vines cover the hill terraces, and twine among the pollard elms and olives. The pendent racemes or bunches of purple fruit are of delicious coolness and flavour in health, and a grateful refreshment to the fevered tongue in sickness; while the produce of the winepress has been the beverage of civilised man, from the days of Homer, who sings of the joyful vintage and the industries connected therewith. The true home of the vine, says Victor Hehn, is the luxuriant country south of the Caspian Sea. There, in the woods, the vine, thick as a man's arm, still climbs the loftiest trees, hanging in wreaths from summit to summit, and temptingly displaying its heavy bunches of grapes.

*Raisins.*—As a proper food product the dried fruit of the vine is of no little importance, and many commodities could be better spared than the "plums" of common language, and the so-called "currants," British taste for which is so

marvellous, that a failure in the Spanish or Greek crop would be felt like a national calamity. Plum-pudding is an established Christmas institution, and poverty can give no sharper sting to the poorest household than to deny a share in this festive rite.

*Wheat.*—Wheat reaches its greatest perfection throughout the wine countries, but it also flourishes in other zones, and therefore does not so well serve as a type of a region to which the vine, for vintage purposes, is limited. Wheat grows within the tropics as a winter crop, but other grains grow there to greater advantage; thus, on approaching the tropics, we see it gradually displaced by maize, and then by rice, the true tropical cereals. Andalusia produces wheat as fine as any in Europe, and is the storehouse of the Peninsula. Nature indeed has endowed Spain with gifts that would make it the paradise of a wealthy and powerful nation, did not the perversity of man frustrate the design. With a climate and soil fitted for the finest agriculture, only a third of the land is arable; and though the harvest is abundant, the corn is oftentimes left to rot upon the fields, the cost of transit being too great, owing to bad roads and banditti. Corsica and Sardinia were the granaries of ancient Rome. In Italy the arable land is covered with the grateful shade of the olive and mulberry, and the vine is trained over rows of trees, beneath which cereal crops are raised. The plains of Lombardy comprise some of the richest vegetable soils, from which four or five wheat crops can be got in succession. Vast breadths of corn again grow upon the plains of Hungary and the Lower Danube. Northward, France and Germany produce large crops; and still heavier ones of wheat, rye, and oats are met with amongst the sandy and swampy lowlands of South Russia. The scene of Russia's extensive but rude agriculture is a tract

of black, thick, vegetable soil,(equal in area to France and Austria combined,)which produces rye—the people's chosen grain—and limitless stores of wheat. This region is bounded by the Great Steppe of the Cossacks, and the saline steppes of Astrakhan. The latter of these boundaries is so impregnated with salt as to be fertile only on the narrow margins of the rivers; but spring clothes the arid soil of the Great Steppe with a rapid growth of thick coarse grass, upon which troops of horses are pastured.

Thus the vine and wheat, with equal propriety, may stand sponsors for this European region, which is also known as the region of the *Oil Countries*, from the free use everywhere made of the product of the olive, although it does not flourish so far north as the vine.

The subdivisions of the zone display distinctive physical features and productions, and an individual character is impressed upon each of the countries forming the subdivisions. Spain differs from France and Italy, and these countries from Germany, Austria, Turkey, and Russia, and from one another, while all are characterised by the grape, wheat, and the olive.

### Southern Subdivision: Physical Features and Produce.

*Spain and Portugal.*—The arid and treeless table-land of the Peninsula betrays its proximity to Africa, and the geological formation of its southern boundaries indicates a former union with that continent. The table-land occupies the whole of the centre of the country, its mean elevation being over 2000 feet. It is not one plain, but consists of a series of terraces, blanched in the summer sun, and subjected to great extremes of cold in the winter. These terraces, rising upwards towards the steep and difficult acclivities of the Pyrenees, are separated by mountain

ridges, of which the Sierra Nevada is the highest, and by rocky gorges, at the bottom of which the rivers flow, at the depth sometimes of 200 feet. Numerous fertile valleys slope down to the shore, where the rivers, useless for irrigation on the table-land, revive the vegetation. The stately chestnut-trees congregate in forests, and the cork and evergreen oaks yield their bark and galls, as well as sweet mast, which is ground into meal, and, like the chestnut, used for bread. Orange groves perfume the air with their flowers; and the golden fruit hanging at the same time from the boughs recalls the fabled garden of the Hesperides. The Biscayan coast, open to the ocean breezes, produces cider and the fruits of a higher zone; but the Mediterranean seaboard, defended by a rampart of inland elevations, is tropical in its warmth. Peaches gain the fulness of their flavour, and melons reach their highest perfection, while pine-apples, figs, and prickly pears grow in every garden. The harvest of hazel-nuts is so great, that, besides what are eaten in Spain, every fruiterer in England shares in the produce. Barcelona, in connection with nuts, of which the surrounding district furnishes the finest variety, is a household word in our own country. The almond and the palm flourish together. The flowering aloe, rare in Great Britain, here forms the country hedges; and all kinds of lemons, limes, and citron are excellent and abundant.

With the minor botany of Spain several important industries are associated. Bees find a plentiful repast in the myriad flowers, and honey is produced to a very large extent. Cochineal insects feed upon the cactus; their nurture and the cultivation of their food are so successful that Mexico, the original source of cochineal, has now to compete with the Peninsula and Spanish islands for the trade in this valued dye-stuff. Silkworm-rearing employs a large number of the Spanish people. Of still greater importance in animal

produce is the merino sheep, whose fleece is of high value; and the famed barbs of Andalusia are amongst the most beautiful of horses. The institution of the *Mesta*, by which baneful privileges were granted to the nobles and priests, who held a monopoly of sheep-farming for generations, protected pasturage at a disastrous cost to agriculture. This institution arose in feudal times; its abuse has obstructed husbandry, while the sheep have in consequence been improved neither in breed nor number. No field once in grass might be ploughed without the sanction of the Mesta, who had a right of way and of pasture, in perpetuity, between the lowlands and the table-lands.

*Minerals.*—Spain possesses at Almaden the richest European quicksilver mines, without which the gold and silver ores obtained from America would have been of little use; the quicksilver being employed to separate the precious metals from their matrices. Lead is found in sufficient abundance to allow of export; but generally, the mineral treasures of Spain, once of national concern, were neglected upon the discovery of America, and the mining industry of the mother country is now only very slowly resuming its proper position. The Peninsula commands the Mediterranean and the Atlantic, and is well placed for communication with the whole world. In the sixteenth century, the two kingdoms of which it is constituted divided South America between them,(Spain also possessing Mexico and Central America,) and for enterprise the Portuguese and Spanish were the first nations in the world. In the present day their commerce is possessed by foreigners, and almost entirely confined to France and England. Spain, however, has made important advance within recent years.

### Mediterranean Seaboard.

*France and Italy.*—France, like England, is a manufac-

turing nation, importing raw materials and sending out finished goods. Nevertheless, it is the chief wine country, and produces beet sugar in abundance, besides a surplus of madder and much fruit for export, as well as many millions of eggs. The mulberry trees that cover a large part of the southern provinces constitute the basis of an important branch of national industry. Although the quantity of silk does not equal that of Italy, yet the silk fabrics of France have hitherto been unexcelled. Iron, coal, lead, and zinc are amongst the minerals of the south of France, iron being specially abundant in the Pyrenean districts. France, washed by three seas, is admirably placed for interchange, which, during the reign of Napoleon III., more than quadrupled in value and extent.

Italy is naturally a land of abundance. It is also the chief silk-producing country of Europe, and yields the best olives and olive oil, straw for plaiting—Tuscan and Leghorn plait being universally admired—sumach and bark for tanning, a fine hemp fibre, and fruits like those of Spain. A large proportion of the people, however, lack the necessaries, not to mention the comforts of life, and those who sow and reap her bountiful harvests are often without bread. Many parts of great beauty and fertility are unhealthy, and districts once crowded are now deserted, owing to pestilential malaria.

The mineral resources of Italy, though vast, are to a great extent undeveloped. They comprise marbles, alabaster, serpentines, boracic acid, sulphur, rock salt, various ores, as those of copper, iron, lead, silver, mercury, and antimony, together with mineral fuel and oils.

*Fisheries.*—The Mediterranean sea-board, both of France and Italy, is notable for its fisheries. The delicate anchovy, preserved in salt, and the sardine, preserved in oil, are ex-

ported in large quantities. The sea, enclosed by Naples, Sicily, and the islands westwards, is the chief scene of the tunny fishery. This fish, sought for its oil as well as for food, represents the mackerel of the British seas, as the anchovy and sardine represent the herring tribe. Along the Barbary coast and off some parts of Italy, French and Italian dredgers engage in the so-called fishery for coral (*Corallium rubrum*). Only in these parts is this dense and beautiful but brittle product found in abundance, employing not only the dredgers, but the lapidaries of Marseilles, Genoa, and Naples, by whom its beauties are so developed that its value often increases to double that of gold, giving rise to interchange with Persia, China, and the most distant countries. The cutting of cameos in imitation of the ancient onyx, which is provided for by the prevalence of beautiful gasteropod shells, is an industry allied to that of the coral, and carried on in the same towns.

*Region of the Danube.*—The Alps send out eastern spurs, with glacier scenery and yawning abysses only next to the main range in grandeur. These spurs, with the still more rugged Carpathians and the Turkish Balkans, give a general mountainous aspect to this region, modified by the corn plains and grazing grounds of Hungary and the marshes of the Lower Danube. Spring clothes the meadows in green, amidst which the daffodil, narcissus, and other liliaceous bulbs grow in wild native vigour, while sheep and cattle find a rich sustenance, and wheat adds greatly to the wealth of the land.

The Danube flows through countries less developed than France and England, and their condition reflects itself in their produce. The surplus for interchange consists almost wholly of raw materials. Nearly a fourth part of Austria, and probably a larger proportion of Turkey, are in forest,

and here many of the finest timber trees reach their most perfect state. Oak trees abound, productive of gall nuts, of valonia for dyeing and tanning, and of a sweet acorn, flavoured like the chestnut.

The forests of the Austrian empire are attendant upon inexhaustible mines, for though the coal-fields, both of the Hungarian and German provinces, are far from inconsiderable, either in point of area or produce, the quality of the coal is bad, and wood is much used in smelting. The mines have been worked from the time of the Romans, but never extensively, and little impression appears to have been made upon the mineral stores. Iron is found in nearly all parts of the empire, especially in Bohemia, Moravia, and other German provinces. Some of the mountains are formed of a pure carbonate of iron, requiring to be quarried rather than mined, and native steel of the highest excellence is found in Styria. The richest European mines of quicksilver, next to those of Spain, are met with in Idria, in the province of Carniola, Austrian Germany. An old proverb says of three Hungarian towns, in allusion to the richness of their mines, that one (Neusohl) is enclosed in walls of copper, another (Schemnitz) in walls of silver, and the third (Kremnitz) in walls of gold.

Wool, silk, and metals are the chief raw substances exported by Austria, whose ancient policy in restricting commerce, in view of keeping her produce for home consumption, resulted in the discouragement of all industry, hindrance to the increase of wealth, and the promotion of extensive smuggling.

Turkey and Greece produce—besides silk, madder, figs, raisins, valonia, and olive oil—some substances more especially their own, as opium, cotton, drugs, and sponge. The fisheries of this last assume, in the Ægean Sea, the place of the Italian coral fishery. Strewn over the rocky

floor of the clear water where the Cyclades repose, sponge cups abound, soft, elastic, absorbent, and free from spicules, silicious or calcareous. Those from the coast of Candia (Crete) are of the finest description, and under the name of Smyrna, Turkey, or Greek sponges, command the highest price in the market.

*Alpine Ridge.*—The climate and soil of this dividing tract are unfavourable to animal and vegetable produce, and nothing economically important characterises it. The mountains, as their geological structure indicates, are deficient in metals and useful minerals. The Swiss are, nevertheless, well clothed and fed; while Italy, so much more bountifully dowered by Nature, depends upon foreign industry for the scanty supplies of half her population.

*Northern Slope.*—While the olive and orange flourish only in the lower latitudes of this favoured zone, the vine reappears on the northern slopes, and furnishes many of the finest wines. The climate and soil are equally favourable for cereals and for the rearing of domestic animals.

## Zone of Wheat and Northern Grains.

*Beer and Butter Countries.*—The designation of the "wine and oil countries" contrasts with that of the next higher zone, whose distinctive produce has gained for it the appellation of the *Beer and Butter Countries.* The two descriptive beverages are linked by the cider, common for some distance to both sides of the line of division. The production of cider, beer, and butter, indicates essential differences in climate, soil, and other physical conditions from the zone of wine and oil. The shades of change upon the face of Nature are very distinct over large areas, but too gradual for comparison within narrow bounds. The out-

skirts of one zone transfuse with the adjacent climes; but the zone itself emerges, in its own unique character, as distinct as a band of the rainbow from the lines with which it blends. Receding, therefore, farther from the tropics, the glare of southern lands is subdued by green pastures, the sustenance of fine cattle and sheep; the brilliant blue of the skies is sobered with grey clouds, from which pour more frequent showers, if not such torrents of rain; and the ocean assumes duller greenish tints. The varied surface of the zone favours the production of excellent crops of all kinds of cereals, and fine timber. The appearance of the vegetation is the combined effect of meadow-land and forest, of cereal and root-husbandry, of orchard fruits and fibres. Vineyards rapidly become fewer, maturing only quite inland, and wine is no longer a common drink. Before reaching the mean limit of wine produce, the hilly districts of Germany present interesting illustrations of the climatic conflict of plants. The vine-clad hills of the Upper Rhine and Moselle strike the beholder as much as the farming of their vicinity, which is that of a more northerly zone. Over the plateaux of Bavaria and Bohemia also, lofty and graceful curls of hop, with loose hanging cones of fruit, challenge comparison with the vineyards of the Rhine and the trellised gardens of Italy. Choice wines are made in a few places, but Bavaria is most celebrated for its beer, of which the inhabitants consume a great quantity. A wag in Munich once described a well-known toper as "a beer-barrel in the morning, and a barrel of beer every night."

In this zone, more than in any other, cultivation has changed the aspect of Nature; for it includes the busy hives of England and France, and the chief mining and manufacturing localities of the Continent. Except in Russia, towns are closely packed, kingdoms are crossed by numerous

roads, highways, railways, and waterways, and the seas are crowded with ships for every purpose of war, commerce, fishing, and pleasure. Each country reflects its own character, notwithstanding a tolerably uniform climate and vegetation. France is laid out with the precision of a surveyor's plan; the departments and communes are intersected by trees planted at exact intervals. Ancient Armorica (Brittany) produces apples and pears in abundance, and the orchards are more pleasing than the southern vineyards. By the law of equal division of property at death in France, the empire has become covered with small allotments, and the hedges, which make England a garden, have disappeared. There is thus a monotony in French husbandry, from which the north only escapes by the profusion of fruit-trees. Every homestead, however, contains poultry, providing eggs and large stores of food, besides an immense surplus for export. Early garden and orchard produce are sent to England.

*Holland and Belgium.*—The Netherlands are cut into chequers by canals, fringed with perspective lines of poplars, the greenness and many vanishing points of which make an otherwise tame country attractive. The same beaver-like industry which protected the Low Countries from inundation has enabled the inhabitants to extort wealth from the rescued lands, and to make the most unlikely places of human residence the most densely peopled parts of Europe. The culture of flax, hemp, and grain—especially oats—cattle-rearing, and dairy-work, are all important industries. Holland had once the commerce of Europe in its hands, and still retains a large share. Its surplus for interchange consists of butter and cheese, provisions, cattle, and hides; flax, tow, oats, and seeds—a description of produce which extends also to the alluvial lands of Hanover and Denmark.

The canals of Holland serve the double purpose of inland communication and drainage.

Where Belgium adjoins Holland it partakes of the same features, but farther south it is hilly and woody; minerals are various and abundant, including almost all the metals of economic value, together with coal, limestone, and freestone. Its mines of coal and iron, especially, create a hive of industry competing with England. The kingdom is a succession of busy towns, so near together, and connected by such populous farms, that it is like the metropolis of a great empire. The animal and vegetable produce of Belgium corresponds with that of the countries adjacent—early garden stuff and eggs as in France, and dairy produce as in Holland. Rabbits are specially a Belgian product, millions being brought from Ostend to the London markets during the cold months.

*Germany.*—Germany, until recently, was split up into many minor states, under different rulers, all claiming old feudal rights and privileges. The husbandry of its varied surface reflected these political features, rather than the rapid advance in science and the arts of production exhibited by other countries. Princes and grand-dukes owned inalienably the greater part of the soil, and claimed powers of free grazing after harvest upon the fields of their tenants. This led to a persistent uniformity of tillage, and checked improvement. With the Fatherland transformed into a united German Empire, the petty restrictions which hampered production and transport were removed; and the country has been benefited thereby immensely in its agriculture, manufactures, and commerce.

Nowhere are green vegetables so fine. The cabbage flourishes so abundantly as to form a national dish, and, under the form of *sauer kraut*, is esteemed worthy of export.

The beet is grown, as in France, for the sugar manufacture, which demands an excessive produce. Rye used to be the common grain, but is no longer the staple of food, and wheat of a high quality is exported by way of Dantzic, which name it commercially bears. The plains of Northern Germany—Pomerania, Brandenburg, Mecklenburg, Hanover, and the adjacent portions of Prussian Saxony—are not generally fertile, consisting chiefly of sandy heaths, forests of fir and pine, with marshes towards the Baltic, and inexhaustible peat or turf, used for fuel. The Baltic coast of Prussia has to be protected from the sea, like Holland. Along these low shores, the fossil resin called amber is found, being abundant in the long narrow tongue of land shooting out from near Königsberg to Memel, whence it is dredged from the submerged forests. Farther west, the Rhine provinces of Prussia, and the adjacent territory, present a remarkably diversified surface of hill and dale, with a soil largely consisting of the decomposed material of volcanic rock, notable for its fertility. These districts possess a climate, and yield products, approaching very nearly in their character to those of the more southerly belt.

Germany is remarkably well watered by small streams, and has good rivers for navigation, their courses throughout the north being mostly slow, through the flat and sandy plains. The central mountain range makes an admirable watershed, dividing the basins of the Danube and the Rhine, and determining the course of the smaller rivers to the North and Baltic Seas. These rivers, and numerous lakes, abound with fish, compensating for the comparative lack of seaboard and marine fisheries.

In Lower Germany—that is, the portion lying north of the central watershed—cavalry horses are largely reared, as well as numerous sheep and cattle. The Saxony fleece

fetches the highest price in the wool market, being long and silky in fibre, and producing a fine cloth.

The forests, in favourable parts, cover a third of the country. Oak, beech, and chestnut fatten with their mast immense numbers of hogs, the bristles and flesh of which are valuable economic products. The wolf and the boar still seek in places the covert of the leaves, and are hunted rather more for the sake of extermination than for produce. Timber is an important item in the national revenue. Thousands of logs float down the Rhine, formed into rafts, out of which in the course of transit a floating village is built, with labourers, their families, and appurtenances for shelter and food.

Flax and hemp are largely grown, the latter attaining sixteen feet in height, and being full of fibre. Every cotter has his patch of land, from the produce of which coarse cloths and canvas are made.

*Russia.*—Entering Russia through the plains of Northern Germany (Prussia), we find a repetition of the picture just described with the features enlarged. The Sarmatian plain reaches to the Urals, without an elevation to break the ocean-like level. The Valdai Hills, the feeble watershed of European Russia, limit the plain to the north, and the Carpathian plateau limits it to the south. Through these flats flow various noble rivers and their tributaries, swarming with sturgeon, producing shagreen and isinglass, and, from the roe, caviare. The Volga meanders wearily for 2400 miles, with a fall of three inches to the mile, till it flows into the Caspian. This river is the grand waterway for the produce of the Urals and Central Russia, and for the commodities interchanged at Nijnii Novgorod, the great centre of inland trade, where merchandise to the amount of many millions is sold during the two months of August and September, while that mart is open. Well-laden barges

float as far as the angle where the river bends abruptly towards its delta in the Caspian. For a thousand miles of its lower course the Volga runs at the base of a cliff, facing the east, and ranging from 200 to 500 feet high —the sea-wall of a pre-historic and vaster Caspian. This elevation of the right bank of the Volga renders canal communication with the Don impracticable, though a mere strip separates the rivers; the barges are lifted bodily at the most convenient spot on to a tramway, and transferred to the Don, whence they reach the Sea of Azof and the Black Sea. Here their freight is sold, and the vessels are broken up for firewood, realising more in the treeless steppes, where cow-dung and turf are commonly used for fuel, than their value if sent back empty to the forest-lands where they were rough-hewn.

Peter the Great, to whom Russia owes its impetus in civilisation, was the first to perceive the facilities of the country for a system of waterways, and he connected the basin of the Volga by means of canals with the Baltic and Arctic drainage. This scheme has since been developed, until an uninterrupted communication now exists between the Arctic Ocean and the Baltic, the Black Sea and the Caspian. For land carriage the finest highway in the world is probably that from St. Petersburg to Moscow, which is twice as wide as any of our own, macadamised throughout, and lined with trees marking the number of versts.* Several other fine roads exist; the chief cities also are being connected by magnificent lengths of railway. Still, as a rule, the cross-roads are bad, consisting of mere tracks; and markets are so difficult of access, that much wealth is wasted, being a long time in reaching its outport. The boundless southern flats, not composed of marsh or arid steppes, or waving with grain, are productive of every kind

* A Russian *verst* equals about three-fourths of an English mile.

of root-crop and of hemp and flax. Russia thus, with barbaric bounty, gives to the nations she feeds, linen for their clothing, and sacks in which to carry their corn.

Upon these plains, multitudes of horned cattle are reared, as well as millions of sheep, from which are obtained the wool, hides, and tallow that figure so largely amongst Russian exports. Beeves roam over the Sarmatian government of the Ukraine in huge herds, whence came, it is generally believed, the cattle disease, from which our dairies suffered so terribly. Horses, likewise, so abound that the Cossacks, the Centaurs of the ancient Greeks, are said to live in the saddle.

The central territory is covered with forests. Woods stretch from St. Petersburg to Moscow almost without a break, and it was a saying that a squirrel might pass from the one city to the other without touching the ground. The largest forests in Europe are round the sources of the Volga. The government of Perm has but an eighteenth of its soil uncovered by trees. Lime, beech, oak, and elm, form distinct forests; while the maple, ash, willow, alder, and other trees are well represented. Towards the north, the birch and pine prevail over all the forest trees. Immense herds of swine range these forests, which also harbour the bear and wolf. The peasants, who, till the late Emperor's reign, were serfs of the great proprietors and sold with the estates, have always been allowed a pecuniary interest in the herds of swine, saving the bristles for itinerant merchants, and feeding upon the flesh. The freedom granted them by the Emperor Alexander has already stimulated their industry and thrift, and led them on in the path of civilisation. Bees in the same districts feed upon the multitude of wild summer flowers blooming in every open part, and build their hives in hollow trees. Prodigious quantities of honey and wax are produced, many Russians having thousands of hives, the care of which is their chief vocation.

Timber is the bulkiest, as well as one of the most valuable constituents of the raw produce of Russia, but it is far from being the only wealth of the forest. Tar, pitch, resin, turpentine, spruce beer, potash, are all useful commodities, and wood for fuel, in a climate so rigorous in winter, is invaluable.

*Minerals.*—Iron is obtained from the Valdai Hills; copper in the hills to the north of Lake Onega; marble from Finland, and salt from the saline lakes in the south-east. The precious metals, including platinum, are found in the Urals, but on the Asiatic slope. The mineral wealth of Russia is thus chiefly in the coldest parts of the climatic zone.

Barley, oats, and rye, with favourable aspects, mature as far north as lat. 70°, and are used as descriptives of the next climatic division of Europe; that is to say—

### The Zone of Northern Grains.

The limit of wheat growth is the northern boundary of the zone we have been studying. Wheat struggles to maintain its supremacy, but with an ever feebler force, as it penetrates the higher latitudes. It succumbs in the British Islands at the level of the sea, at 58°. In Norway wheat ripens at Drontheim in lat. 64°; the limit descending thence to St. Petersburg in lat. 60°, and still further south in the Russian interior.

This region severs the north Scottish Highlands from Great Britain, takes in the greater part of the Norse peninsula, and, in an irregular line, crosses Russia to the Urals. The southern limits are comparatively mild; the northern limits are perpetually frozen; and the chill shade deepens in passing from the one to the other extreme. An Arctic vegetation is all that the Scotch hills possess,

although the Gulf Stream keeps the western channels free from frost. Norway enjoys the like immunities; its inlets and fiords, from the Naze to North Cape, are clear of ice, and vessels can steer round Mageröe all the year. Yet on the mountain ridge, a little distance inland, the snow line descends to the lowest elevations, and glaciers glide to the very verge of the frozen Baltic.

*Arctic Russia.*—The shores of Arctic Russia shelve, cliffless, down to the ocean, descending like the snowdrift direct into the water. Without a rampart from the polar blasts, there is an intensity of cold in these lowlands not counterbalanced by genial winds.

*The Baltic.*—The shallow and tideless Baltic has scarcely a sounding that could submerge St. Paul's Cathedral, and the pine-trees around would show their crowns if planted in any other part of it than the Gulf of Bothnia. Its navigation is impeded by shoals and banks. Being nearly landlocked, it is little affected by the ocean, and is fed only with fresh water. Open also to the polar winds that freeze the many lakes of Finland, the Baltic becomes in winter a solid highway between Russia and Sweden for sledges, and traffickers with their merchandise poised on their heads. Merchantmen are ice-bound before Cronstadt; the morass upon which the Russian capital is built feels the rigour of months of frost. Famished with hunger, the wolves leave their lair, making night hideous, and filling the droschky drivers' hearts with fear.

*Lapland and Finmark.*—The ungainly reindeer turns up the Lapland snow with his shovel-like antlers, for the "moss" or lichen, which, by Nature's provision, is longest and most profuse in winter, when other food cannot be got,

and thrives upon such scanty pasturage. The rich Laplander counts his patriarchal wealth in reindeer, often owning a thousand, just as at the other extreme of climate the Arab numbers his wealth in camels. The reindeer, like the camel, combines, in the service of man, the whole range of usefulness of our domestic quadrupeds. Where the ox, sheep, and horse would perish from the climate and want of sustenance, these representative creatures give their flesh and milk for food, their skin for clothing, while they are patient beasts of burden, and satisfy numberless human wants.

Winter, in the greater part of this zone, lasts for nine months in the year, coming suddenly, without autumnal preparation, and breaking forth into summer without the intervention of spring, when, says the proverb, "a man may *hear* the grass grow." As soon as the cheerless season has passed, the snows melt on the Norwegian hills; cataracts take their headlong leaps and flash their surcharged waters into winding inlets, eager to join the ocean; the swollen streams burst with the force of a deluge, and devastate the lowlands lying between.

*Forests.*—Only at this season are the rivers full enough to carry to the sea the burden of timber, the great constituent of Scandinavian wealth. In many places transit cannot be accomplished, and the forests, in their lonely solemnity, unmolested by man, breathe forth the mournful wail peculiar to the pine tribe.

*Sea-fowl.*—Innumerable sea-fowl skim the surf or sweep the sky. Responding to their instincts, they line their nests with down, of the thick undergrowth of which they are twice rifled by the daring fowler. The fiords of Norway, the Baltic coasts of Bothnia, the polar shores of Russia, and

the islands of the Arctic Ocean are alive with sea-fowl. Besides affording the luxury of eider coverlets and beds of elastic down, their flesh is useful, where so much else is denied, and their quills are a constituent of commercial wealth of which Riga is the chief depôt.

*Fisheries.*—A teeming world of aquatic life exceeds in number, if not in interest, the feathered one. The species are few, but the individuals—as is distinctive of the polar zones—are numerous beyond computation. Fishermen haunt every fiord as well as the open sea, capturing millions of cod and other fish, which they salt for markets as distant as Spain and the Mediterranean, and the streams are tenanted with salmon. Fishing and fowling are the sole maintenance of the granite group of the Lofoden Isles, to the great cod fishery of which men resort from all parts of Norway. Billingsgate relies upon Norway chiefly for its daily stock of lobsters, the consignments amounting annually to a surprising value. Fish-oils, for the purposes of illumination as well as for food, are sought from the seal, and from a kind of shark, the liver of which, containing several gallons of clear oil, is the only part regarded.

*Revival of Industry.*—As summer advances, the whirr of many water-mills blends with the roar of the floods, and industrial sounds reverberate. The mining districts are animated with busy labour, Swedish, Laplandish, Finnish, and Russian. Emphatically, the husbandman "works while it is called day." Stockholm, the Swedish Venice, glistens in the waters of the archipelago upon which it is founded, and merchandise, unlocked from its icy moorings, gives life again to the Neva.

Grass grows on every patch of soil, and flowers gladden the ground suddenly, as if touched by a fairy wand. Larks

and nightingales make the sky echo with song. Barley, oats, and rye may be measured in their daily growth. They are in seed, blade, and ear, ripened and reaped, within the brief three months' summer. In this short season, the niggard plains of Lapland produce corn, and potatoes, and butter, for export to Sweden.

An arch of liquid blue, dashed with tufts and patches of pearly vapour outdazzling the sea-foam, with a procession of clouds, tinted by sunbeams, scudding beneath, is Nature's glorified canopy. Each day the sun remains longer above the horizon, and each night's dispersion of heat grows less. The lengthened day accumulates heat, and tempts out the gnat-like insects: the reindeer is punctured with the stings of the gad-fly; midsummer comes before the first summer greetings are over, and then, in the farthest north, the sun sets and rises without leaving the horizon.

### Gradations in the Fauna and Flora.

*Fauna.*—Interesting gradations in the fauna and flora are observable through the zone. Animals being limited by the prevalence of their food, it is only in the lower and milder latitudes that the common domestic cattle are found. The deer is stalked in the hills of Scotland, and the elk in Sweden. The wild ox is rare even in Russia. The bison or auroch is now almost, if not exclusively, confined to the forest of Bialowikza, in Lithuania. Excepting reindeer, the animals, beyond the confines of wheat, are almost exclusively flesh-eaters. Bears are not fastidious in their diet, but the polar species is wholly a beast of prey. Nature, however, indulgent in her harshest moods, adapts the beaver, sable, ermine, and fox to an abode amongst the snows, and offers their thick and warm furs as a compensation to man for braving the bitterness of a polar winter.

*Flora.*—The most northerly point to which wheat reaches is 64° : rye, oats, and barley ripen as far as 69° or 70°. The potato and green vegetables grow at North Cape in about the same latitude, but only in lower latitudes inland. Berry fruits, such as cranberries—of which many casks are exported from Russia—strawberries, bilberries, and currants, enhance their flavour in this zone to an excellence unknown in England. Trees have a wide range, their vigour, however, being checked in approaching the pole. The beech and elm extend as far north as 60°. In Sweden and Norway the oak reaches 62°, and the lime, which in Russia forms the largest European forests, reaches 63°. The firs reach 68° N., and the willow and birch slightly beyond the potato limit. These high latitudes, nevertheless, are attained only in the parts influenced by the Gulf Stream. Inland, owing to the greater cold, the limit falls short by five or six degrees of latitude. The birch, at the Isle of Hammerfest, does not exceed the height of a man, and at the extreme limits, half-a-dozen full-grown trees of the dwarf species could stand, it is said, on an octavo page. Coniferous trees retain their energy beyond the normal range of the leaf-shedders, and are amongst the last to disappear. Local physical amenities, however, occasionally reproduce examples of these trees, so that the birch, mountain ash, and Scotch fir are not finally arrested before reaching latitude 70° N. Within a few leagues of Tornea, there are forests of birch and spruce, the trees attaining a height of twenty-five feet, and a girth of two feet. Beyond the limit of trees, vegetation dwindles down to ground berries, saxifrages, and flowerless plants; still a few mosses, lichens, and grasses struggle for existence as near to the pole as explorers have been able to penetrate.

## CHAPTER X.

### ASIA: CLIMATE, SOIL, RAW PRODUCE.

General Description—Climate —Mineral, Animal, and Vegetable Produce—Plants peculiar to Africa and Asia.

EUROPE and Asia are strictly but one continent, lying mostly in the same latitudes, and having many features in common. While, however, Europe barely trenches on the region of palms, Asia extends through the sub-tropical zone, and has one seventh of its surface within the tropics. Compared with Europe again, the climate of Asia is colder than the latitude would indicate; the line of permanently frozen sub-soil descending in the coldest parts of the interior to latitude 50°, which is 20° farther south than on the west coast of Europe. Similarly, the limits of cultivation of the useful plants, by which we divided Europe into botanical zones, are modified in Asia, yielding to the tendency to descend. The vine, which flourishes at 50° in inland parts of Europe, nowhere ripens beyond 45° in Asia, its native soil, where the wild grape is a common plant, and sinks to 35° on the Pacific coast. The region of palms, which includes Sicily in the west, slants south-eastwards to Canton on the Tropic of Cancer. Bearing this tendency in mind, we may trace the zones and sub-zones of growth, descriptive of Europe, across the continent of Asia, allowing for a variable southward deflection of from five to ten degrees of latitude.

The climate of the northern, eastern, and central parts is subject to great extremes of heat and cold in the summer

and winter respectively; but only in the east and in the islands can it be described as variable. It is very dry and cold in the north, and upon the central table-lands; but hot and humid in the south, where there are only wet and dry seasons, without any winter.

Various causes produce the peculiarities of temperature thus adverted to. The magnitude of the surface of Asia gives it a true continental as contrasted with an insular climate. The land absorbs and radiates heat more readily than the ocean. In summer, therefore, the spacious table-lands and plains of Asia accumulate a vast store of heat, which they give off again in winter, and between the two extremes there is a great range unqualified by any of the equalising influences of the sea. The approximation of the land to the pole is another cause of low temperature. The flatness of the northern regions interposes no barrier to the cold blasts from the icy ocean, while the Himalaya range and its adjuncts effectually shut out the hot and the moist winds of the tropics. One result of the dryness of the northern atmosphere is that the snow-line of the Himalayas is 3000 feet higher on the northern slope than on the southern counter-slope. The district of the greatest cold is in Siberia, where a mean winter temperature of 40° below zero is met with on either side of the lower course of the Lena, from Yakoutsk to the sea. The district of the greatest heat is in Arabia, where a mean annual temperature over 90° is met with on either side of the Tropic of Cancer, extending across the Red Sea and Nubia into the interior of Africa. Thus in every way, Asia is the continent of extremes. The cold of Siberia is so intense and permanent in its effects that the greatest heat of summer cannot thaw more than four or five feet of the soil. As an example of climatic extremes, we may take China. Pekin, the capital, in about the latitude of Naples, has an Egyptian summer

and a Russian winter; and the summer of Canton, in the south, is hotter than that of India, being less favoured with sea breezes, and less elevated.

"Nature," says Malte Brun, "has given to each of these regions a physical character, which human industry will never succeed in changing, or even in modifying in a sensible degree. As long as the present equilibrium of the globe shall continue, the ice will pile itself up in the mouths of the Obi and Lena; the winds will whistle in the deserts of Shamo, and Thibet will not see the snows of its Alps disappear before the rays of the sun, which at so little a distance scorches the tropical regions. Thus the Tartar is called to the agricultural and pastoral life, as the Siberian is to the chase. India, in appearance more fortunate, owes in great part to its climate that effeminacy, that indolence, which invites foreign robbers and domestic tyranny."

**Soil.**—South of the Himalaya range, and in China, the soil may be described as very fertile. In the north, steppes, and tundras or frozen bogs, prevail. Much of the central table-land, and the countries in the same line, are deserts, generally saline. In fact, the great desert region of the world, unbroken except by fertile strips of soil near rivers, such as the Tigris and Euphrates, or by a mountain chain, may be traced from the Atlantic, on the western coast of Africa, nearly to the Pacific, on the east of Asia.

## *PRODUCE: MINERAL, ANIMAL, VEGETABLE.*

The expanse of Asia is so vast that every geological condition is represented, and consequently minerals of every kind are found. Diamonds and other precious stones are found in Hindostan and Siberia, whence have come almost all the world-famed jewels. Borneo and the East India

islands produce precious stones. Borneo also exports large quantities of antimony. Gold is found in Siberia, India, the Chinese empire, and Japan. Silver is found in the same countries, and in the Turkish dominions. Siberia also produces platinum. Tin and galena in large quantities, and some amount of gold are obtained from the Malayan peninsula, and from the islands to the south. Both metals are also met with in China. Perák, the synonym for silver, is very rich in metals. Malacca or Malaya is believed to be, by some authorities, the Mount Ophir of the Scriptures, and a hill there still bears that ancient name. Copper, iron, and lead, are found in many parts. Quicksilver is obtained in Japan, the Chinese empire, and in Ceylon. Coal is worked in China and Hindostan, and exists, as yet unworked, in adjacent territory. Salt is the common product of most parts of Asia, though scarce in some countries; in the interior of Hindostan it becomes one of the chief commodities imported. Graphite is mined in Siberia, and a deposit of unknown richness has been traced through the ice-bound solitudes of the great river Tungouska, which appears to place Russia far in advance of all the world besides, in the produce of this archaic record of earth's earliest coal.

### Animal Produce.

In Asia is the probable centre whence came our domestic animals, all of which are represented in the several faunal zones. Besides these, there are domestic animals which have not become diffused through Europe. Thus, in the desert regions, the horse is displaced for draught by the camel, an animal so early subjugated to the use of man, that human history fails to go back to a time when wild camels were known. The elephant succeeds in the south and south-east, where the large quantity of rich succulent

vegetable food required by this enormous beast abounds. The one-hunched Arabian camel, or dromedary, ranges across Africa, Arabia, Persia, to the great central table-lands. The two-hunched or Bactrian camel then takes its place, and extends as far north as the latitude of 50°. The Siberian reindeer, on the other hand, descends from the north as low as the same latitude, and the representatives of the hottest and coldest climes meet along this line. The stock of elephants is constantly recruited by snaring and taming wild ones, the tame animals seldom breeding while in subjection. Horses abound over these parts, but the domesticated varieties are almost solely used for riding and war. The ass of Asia is a beautiful animal, chiefly found in the south-west countries, both in a wild state and reclaimed. The Brahmin ox is a sacred animal amongst the Hindoos, and treated with scrupulous reverence. The Angora goat of Asia Minor and the Thibet goat are celebrated for their long and silky hair. The pig is favoured by the Chinese, but is abominated as unclean in the Mohammedan parts of Asia. Wild horses, cattle, sheep, asses, and elephants live in herds or flocks, and furnish the kips or small hides, the skins, wool, horn, and ivory so largely exported. Other animals never yet subjugated are still productive of many useful commodities. Such are the lion, tiger, leopard, jackal, wolf, and bear, whose skins are highly valued; and various kinds of deer and antelopes, the prey of packs of wolves and jackals, or of the solitary lion and tiger. The fur-bearing animals and other carnivora of the northern plains correspond very closely with those of Europe in the same zone, and are as eagerly trapped for the sake of their costly skins.

The names of our common fowls point to Asia as the centre whence they were diffused, and to the fact that they made their appearance in Europe much later than other

domesticated animals. Fowls are nowhere depicted on Egyptian monuments or referred to in the Hebrew Scriptures, though geese and ducks were well known to the ancients. The Bantam variety has been long known in our country for its courage and fighting propensities. The Cochin-China fowl has been introduced into Europe during the present generation. South-eastern and Further India abound with the wild stock of all our pheasant tribe. There are few warblers in Asia, and the range of the nightingale ends in Persia; but the plumage of many birds is unequalled. The feathers of the gold and silver pheasant, of the peacock, and of the ostrich of Arabia, are of great value for dress and decoration. Parrots are also very numerous.

Porcellaneous and nacreous shells of every variety of size and beauty are found on the varied shores of Asia, suitable for ornament, for cameo-cutting, and for the manufacture of mother-of-pearl. Of the pearl oysters, properly so called, none have been so long notable as those dived for along the Cingalese and Coromandel coast, and in the Persian Gulf. There are less productive pearl fisheries in the Red Sea and on the American coast.

### Vegetable Produce.

The same physical causes that give variety to animal life in Asia, influence in like manner the vegetable produce. The floral zones are less irregular than the faunal, for while animals are limited in their range by the prevalence of food, or by their special adaptations, their capacity for locomotion gives them a power of widening or modifying their range, not possessed by plants.

The flora of Asia consists, in the first place, of plants indigenous to the continent, but now also diffused through other parts of the world; in the second place, of indigenous plants not yet diffused: in the third place, of plants which have spread by nature, or have been introduced by man.

Viewing the flora as a whole, we may say that Asia has given much and received little. It is the native home of most of our useful plants, as well as of our animals. Its flora and fauna are now the most exuberant, both in number and kind, on the surface of the earth, and its kingdoms are the most densely peopled. The conditions of life are here fully developed, excepting in the northern plains, on the central table-land, and in the deserts, where climate and soil allow but little growth either of trees or plants.

European fruits are mostly of Asiatic origin. The vine, olive, orange, lemon, cherry, almond, walnut, peach, and fig still grow wild in the wine and olive zone of this continent; the olive principally west of Hindostan, the vine in great perfection in Turkey and Persia, and ranging across to China. The pine-apple is so common in India as to be almost valueless.

Of our flowers, the China aster and Chinese primrose, with a whole host of recent introductions bearing the specific name of *Japonica*, or Japanese, tell their own origin. The camellia, damask rose, hydrangea, chrysanthemum, weeping willow, and many others of our choicest flowers and ornamental trees, have been brought from China and other Asiatic districts.

Of grain common to Europe, Asia produces, in its corresponding zones, rice and maize, wheat, millet, and barley; with oats and rye in smaller proportion. Rice, barley, millet, and rye are probably indigenous. The vegetation of Siberia and Manchuria is the same as that of the like parts of Russia in Europe.

It is, however, in the sub-tropical and tropical countries that the flora of Asia is exhibited in its fulness of power and beauty. Botanically this is the region of palms, the northern boundary of which sweeps, with local circumstances of climate, across the Old World, from about 25° to 40° of

north latitude, touching Europe only in the extreme south of Spain, Italy, and the Morea. The whole region of palms is a band of an irregular breadth, being 40° wide in its narrowest part, and 70° in the widest part, and is situated pretty equally on each side of the equator. It takes in the whole of Africa, with the exception of Cape Colony, and the northern half of Australia. These boundaries are nearly conterminous with the limits of rice growth, and are circumscribed, at a mean distance of about 5° north and south, by the limits of vine culture.

### *AFRICA AND SOUTHERN ASIA.*

Of the many species of palms, the date and the cocoa-nut palm are the most distinctive. The date-palm ranges across the deserts of Africa and Asia, from the Atlantic to the Himalayas. The district of cocoa-nuts is from Ceylon eastwards to the Pacific, this palm loving the neighbourhood of the sea. The date is the principal food of the roving desert tribes, who wonder how people can live elsewhere without it. Rice is the chief food of the densely-peopled countries of India and China. The sugar-cane is cultivated in Africa as well as in Asia, and coffee, now so extensively grown in Arabia and India, is supposed to have spread from Abyssinia. The distinctive fruits of the wine and oil countries, oranges, peaches, pine-apples, figs, and almonds, range also through the region of palms. Palm-oil is produced exclusively in Africa, and correspondingly, cocoa-nut oil is obtained in Ceylon. This last oil is more properly designated *coco-nut* oil, being the fruit of the *cocos nucifera*. Cocoa proper, from which the beverages cocoa and chocolate are prepared, is the produce of the *Theobroma cacao* or cacao bean, quite a different plant. This distinction between the two products saves error, and is now generally adopted.

Teak and other timber trees are common to both continents, and cotton is a universal product, every part of the zone proving its capability of cotton growth during the American war, when our supplies from the United States were stopped. The area of supply expanded so rapidly that our importations when at the lowest amounted to 300,000,000 lbs. The accidental stimulus to production being removed by peace, the reaction has been violent, and supplies have sunk to zero in many promising places, as rapidly as they are recovering former dimensions in the Southern States. Egyptian cotton is of fine quality, and in India there is not a spot but produces one or another variety. China, too, has been noted, time out of mind, for a buff-coloured staple called nankeen.

The animals of Africa are akin to those of Asia, but very few of them have been tamed. Of useful animal products, a description has been given in connection with the British settlements and colonies in Africa, to which may be added silk, which connects Europe, Asia, Africa, and Australia. All silk countries rely mainly upon China and Japan—whence the silkworm first came—for their supplies of grain or seed, as the eggs are called, in which a large trade is carried on.

**Plants peculiar to Asia.**—Some of the most esteemed woods for cabinet-making, as rose-wood, satin-wood, sandal-wood, and ebony, come from Further India. The sago, areca, and other varieties of palm are characteristic of particular districts. Many gums, resins, balsams, and drugs are still only obtained from Asia. The most peculiar plants are, however, limited by nature to a narrow area of cultivation, from which they cannot be removed without destruction, or the loss of their principal properties. Such are the spices and tea. Several of the spices flourish nowhere so well as

in their small indigenous centre. It is a natural law that when a plant is transferred to another centre it will develop new qualities, oftentimes improved qualities; but in the case of these spices, transference has always ended in death or deterioration. China formerly engrossed the production of tea, although the shrub is also indigenous to Assam and the Eastern Himalayas, where efforts have long been making to encourage its growth. So much success attended its cultivation that Indian tea now rivals the Chinese product. The magnitude of our Indian trade in the fragrant leaf swells at such a rate yearly, that the two sources of supply must soon reverse their order of precedence. Plants introduced from China flourish luxuriantly and supplement the native Indian growths. Assam teas compete with advantage, being free from adulteration. Ceylon tea is also proving successful. Japan prepares the leaf, and has opened many of its ports to trade. Both China and Japan are admirably placed in connection with the Great Pacific Railway now traversing the Dominion of Canada; a great shortening of the old sea route to and from England will be thus accomplished; new fields of enterprise and fresh markets will also be opened out. Attempts have been made to encourage tea cultivation in America, and, with better results, in well-suited parts of our Australian Colonies. The native tea-growing districts are, however, so little affected by these outside efforts, that our dependence may, for the present, still be described as on China and Assam.

**Plants introduced into Asia.**—The only plants of importance which Asia owes to other parts of the world are maize and tobacco, both from America. Tobacco, which was unknown in the Old World till brought from America, is a remarkable example of the diffusion of plants. Its

growth is now nearly universal through a zone between 80° and 90° wide in both the New and the Old World, and its consumption is general over the whole earth. Some of the choicest growths are obtained from Asia, such as that of Latakia and of Manilla. Various species of the *Cinchona* of South America, yielding Peruvian bark, are also instances of the transference of important plants to Asia.

**Southern Boundary of Vine Growth.**—The southern limit of the region in which the vine would flourish for vintage is in a higher latitude than the limit of palms, and can be only marked upon the ocean. It runs nearly parallel with latitude 40° S, and the isothermal line of 60° mean annual temperature, deflecting about 10° south near Australia, and thereby comprising Tasmania and New Zealand.

The limits of wheat and northern grains are without analogues in the south, inasmuch as no part of the Old World extends to such high latitudes as 50° or 60° south. Nevertheless, wheat flourishes in perfection within so much of the zone of its growth as is comprised in the territories of New Zealand and Australia.

## CHAPTER XI.

### THE NEW WORLD: NORTH, CENTRAL, AND SOUTH AMERICA.

Climate—Temperatures of Old and New World compared—Soil—Raw Produce, Animal, Vegetable, and Mineral.

**Climate.**—A survey of any good map suffices to show that the New World must, of necessity, differ materially in climate from the Old World in corresponding latitudes. Its chief mountain ridge runs north and south, or nearly at right angles to the mountain ridge of the Old World. The counter-slope of this ridge is narrow; consisting in South America of a long strip of coast, descending precipitously towards the Pacific Ocean. The great expanse, therefore, of the continent, is eastward, towards the Atlantic. This difference of direction between the two continents is very remarkable.

Although the New World stretches through every zone, yet its average temperature, compared with that of the Old World, is lower. The Pacific, or western coast, is warmer generally than the Atlantic or eastern coast, corresponding, in this respect, with the western and eastern boundaries respectively of the Old World. These variations and resemblances are summarised in the appended table of the floral zones.

If we connect the corresponding points of the two hemispheres by lines across the Atlantic and Pacific Oceans, we complete the botanical belts encircling the world. We

also see that the Arctic vegetation has no analogue in the southern hemisphere, the land not extending, with the exception of Patagonia, even to the limit of wheat, and thus falling far short of the limit of hardier grains and of trees.

| BOTANICAL REGION. | NEW WORLD. | | OLD WORLD. | |
|---|---|---|---|---|
| | West Coast. | East Coast. | West Coast. | East Coast. |
| Approximate Northern limit of Trees. | N.L. 64° | 58° | 71° | 63° |
| Southern ,, Trees. | S.L. — | — | — | — |
| Northern ,, Grain. | N.L. 60 | 50 | 69 | 60 |
| Southern ,, Grain. | S.L. — | — | — | — |
| Northern ,, Wheat. | N.L. 51 | 48 | 64 | 50 |
| Southern ,, Wheat. | S.L. 45 | 42 | — | — |
| Northern ,, Vine. | N.L. 40 | 40 | 45 | 40 |
| Southern ,, Vine. | S.L. 34 | 36 | 35 | 38 |
| Northern ,, Rice. | N.L. — | 32 | 42 | 45 |
| Southern ,, Rice. | S.L. — | 25 | 25 | — |
| Northern ,, Palms. | N.L. 27 | 36 | 35 | 30 |
| Southern ,, Palms. | S.L. 34 | 35 | 32 | 32 |

## *NORTH AMERICA.*

We may infer from the contour and vertical relief of North America many of its climatic features.

(1.) The land is broadest in the north, where it expands to embrace the pole, and at the same time lies so low as to interpose no barrier to the Arctic blasts, which sweep down from the north. (2.) The tropical lands taper to an isthmus; there is, therefore, but a small part of the continent in the torrid zone, and even this is mountainous. (3.) The west coast consists of mountains and table-lands, which prevent the warm and humid winds of the Pacific from crossing the country; while the minor Appalachian ridge, on the eastern side, completes a broad valley for the Mississippi—the uninterrupted channel for the northern winds

from the pole to the Gulf of Mexico. We see, in consequence, that the central lowlands must be the coldest part of North America—a fact marked upon the map by the deflection of the isothermal lines.

One further element of climate must be taken into account—that of the marine currents. The Pacific currents, not so well investigated as those of the Atlantic, contribute from their direction to raise the temperature of the western coast. The Atlantic currents have already been considered in relation to the climate of Europe. Let us now trace their influence upon the climate of America. The source of the Gulf Stream is in the Gulf of Mexico, where the heated waters, instead of giving life and health as they do to our own country, increase the pestilential nature of the swamps of the Mississippi delta and the Florida shores. At Cape Hatteras, the Gulf stream curves away from America in a north-east direction across the Atlantic. The ameliorating powers of the current are thus carried away from the continent where it originated, and in its room, Arctic counter-currents sweep along the east shores of Greenland and down Baffin's Bay. These cold currents united, stream along the American shores, rendering the neighbouring lands hopelessly barren, almost to the 45th degree of latitude. Such is the force of the Arctic counter-current that it brings the icebergs, formed from the Greenland glaciers, southwards to the Gulf Stream, where the denser and colder waters sink below the warm flood, still driving the icebergs onward in opposition to the surface flow, till the higher temperature dismantles their pinnacles, and dissolves their masses. Thus are created the almost perpetual fogs of Newfoundland. The limit of icebergs in the Atlantic is about 45°, the latitude reached in Europe by the vine. Inland, two or three degrees farther north—on the same parallel with Brittany and Normandy—the ground is covered

with snow for more than half the year; and beyond 50° —a latitude which London exceeds by nearly two degrees—there is scarcely any cultivation. The vast forests of the American plains tend also to lower the temperature by intercepting the sun's rays, and thus preventing absorption of its heat. The enormous clearings, on the other hand, have already sensibly modified the climate.

Nevertheless, the summers of North America are hot. Its climate is essentially extreme, both from the extensive range of territory, and also from its being shut out by the mountains from the equalising ocean winds. Only the table-lands and mountains of the west are exceptional. The Mexican table-land enjoys continual spring, the causes of which are easily seen. The isthmus connecting the north and south continents exhibits every phase of climate in vertical zones, from the almost unendurable tropical heat in the valleys, to mountain elevations of Arctic severity, and the line of perpetual snow.

## *SOUTH AMERICA.*

The bulk of South America is tropical, and its southern part diminishes in breadth rapidly on approaching the pole. The climate of South America is, therefore, latitude for latitude, of a higher temperature than that of North America. The table-land of Quito (9000 feet), like that of Mexico, is ever vernal, and the Andes of the equator range through all the vertical zones of vegetation. The region of Patagonia, riverless and hilly, is dry, cold, and barren.

**Soil.**—The New World is pre-eminently the country of great plains, through which flow the longest rivers in the world. These plains, except where physical conditions evidently forbid, such as in the Arctic lowlands, are generally fertile, the river valleys being exceedingly so, and in particular, the basins of the Mississippi and the Amazon. Parts of the

plains, both north and south, are barren, and sometimes salt, but there are no *deserts* to compare with those of Africa or Asia. A fourth of the soil only is reckoned as unproductive.

The great central plain of North America is divided by a watershed 1000 to 1500 feet high, in latitude 49°, into the Mackenzie and the Mississippi lowlands. The Mackenzie lowlands form a very gentle declivity consisting of swampy and frozen marshes. The Mississippi lowlands comprise the prairies (the French name for meadows) and savannas (from the Spanish *sabana*, a sheet). These plains are treeless but fertile, the prairie grass growing upon them to the height of ten or twelve feet, and covering spaces to the eye like limitless seas of vegetation. Many thousands of square miles of the same lowlands are covered by the forests or backwoods of North America, and the whole plain, from the Arctic Ocean to the Gulf of Mexico, exceeds Europe in size.

There are three distinctive river plains in South America. —1. The *Llanos* (Spanish, level fields) or plains of the Orinoco. These are grassy flats, covering 150,000 square miles, between the equator and 10° north latitude. So level are the llanos that, at 500 miles from the ocean, the ascent generally is not more than 200 feet. The greater part of the region is inundated in the wet season, to which is due its peculiar character. As the water disappears in the dry season, it is followed by a rapid growth of grass, which in turn becomes parched and very combustible, and conflagrations occur over thousands of miles.

Humboldt speaks of these terrestrial expanses as more awe-inspiring than the highest mountains. There is nothing in the landscape to soften the feelings of sadness and gloom, where everything seems silent and motionless, and during thirty days' journey the plain appears to ascend to the sky,

and the vast and profound solitude looks like an ocean covered with sea-weeds.

2. The *Selvas* (Latin *silva*, Spanish *selva*, a wood).—The selvas or woody plains of the Amazon, cover nearly the whole drainage area of that river, an extent of 2,000,000 square miles. The selvas are the largest forests in the world. Favoured with abundant moisture and tropical heat, the trees attain dimensions rarely seen elsewhere, their height reaching generally from one hundred to two hundred feet. The rankest profusion of climbing plants, which are the growth of a soil the rich produce of centuries of vegetable decay, twine round the trunks to the top, and, reaching over, interlace the trees, and, combined with the thick undergrowth, constitute a wall of vegetation impregnable except to the constant strokes of the hatchet.

3. The *Pampas* is the native name for the treeless plains of the basin of La Plata. They are covered with grass where watered by the affluents of that river, but arid and withered out of reach of these streams. There are, however, extensive tracts of a different character. In the northwest thistles and other prickly plants take the place of grass, and grow of amazing magnitude and number. There are also sandy and saline deserts. *Las Salinas*, a salt desert in the north, is 30,000 square miles in extent. Near the Andes the plains become boggy.

*Mineral Produce.*

The geological structure of America is eminently favourable for mineral deposits. The whole length of the great mountain ridge, from the British territories in the north to the point where the Andes leave the mainland, and form the Patagonian archipelago, is more or less metalliferous. The same may be said of the hilly parts of Canada, and also of the Alleghany region of the United States, but not of the West Indies. Besides the Andes, properly so called,

the adjoining territory of Venezuela is rich in metals, as are likewise the mountainous parts of Brazil. The minerals of South America are more restricted as to locality than those of North America; the immense woody plains of the Amazon, without a hill and without stone or mineral, separate the western metalliferous regions from the eastern.

Gold and silver have been sought to the neglect of the common useful metals, although these last are probably more profitable to work.

## *NORTH AMERICA.*

Gold, silver, tin, quicksilver, copper, lead, and iron are found in North America. Mexico is rich in gold, the gold-bearing strata extending southward into Central America and northward into the richest gold-fields of the continent, those of California. Gold is found in smaller quantities in the eastern States of the Union, chiefly within the high grounds of the Alleghanies or Appalachian region. Mexico alone produces silver, tin, and quicksilver. Mines of copper and lead exist in Mexico, the United States, and Canada. Iron is produced in the same countries, and also in Guatemala. Plumbago is abundant in Canada, and is found in the United States, where likewise a great quantity of zinc exists. The produce of the quicksilver mines of California surpasses that of all others, and regulates the price of this valuable metal in every market of the world. Its essential use in separating vein-gold from the quartz in which this last metal is embedded, has stimulated the working of the mines in recent years.

Next to the metals, the chief mineral produce is coal. The coal-fields of the United States are the largest known, embracing an area more than double that of Great Britain. These immense deposits lie chiefly within the western slopes of the Alleghany region—Western Pennsylvania, Ohio, and

Virginia West—in the peninsular tract of country between the great lake basins of Michigan, Huron, and Erie (state of Michigan), and in the region extending across the lower Missouri and Arkansas rivers, including the diversified tract of the Ozark mountains. These vast stores of coal are, however, but little worked, and the produce of the United States is less than a sixth of that of Great Britain, and hardly exceeds the yield of the little kingdom of Belgium.

In Canada the vast Laurentian and Silurian deposits forming the chief part of the river valley of the St. Lawrence oppose the occurrence of coal, but New Brunswick and Nova Scotia, both now included in Canada, have workable coal-fields. On the other side of the continent, coal of excellent quality is procured in the adjacent Vancouver's Island, and is wrought to a considerable extent.

Canada has other rich mineral resources. The shores of Lakes Huron and Superior yield abundance of copper, and possess, besides, ores of zinc, lead, and plumbago; petroleum or mineral oil, obtained recently in enormous quantities from the carboniferous area of the United States, and from that portion of Upper Canada lying between Lakes Huron and Erie, must be added to this brief survey of the New World.

Salt is common in many parts of the North American continent. Some fine specimens of marble are quarried in Canada, and in the United States, where also slate and asbestos are found.

## *WEST INDIES.*

The rocks composing the larger and smaller islands differ respectively in their lithological character, and therefore in their mineral produce. In the small islands of volcanic origin, metallic lodes or ores are rare. Porto Rico produces gold, which also occurs in Central America, where

there are good mines, as in Chontales (Nicaragua). Copper and iron are found in Cuba, and lead in Jamaica. Almost all the metals are believed to be represented in St. Domingo, together with coal, and numerous other minerals. Rock salt is now mined in Cuba.

## *SOUTH AMERICA.*

The metals of South America are the same as those of North America, but only one lead mine—an argentiferous galena—has yet been discovered, that of Carupano, Venezuela. In Columbia is found the nearly infusible and rare metal platinum, which is unknown in the northern continent. Peru is the principal metalliferous region; its produce being gold, silver, and copper, in common with other districts, and mercury and tin, peculiar to itself. Gold is supplied by Columbia, Venezuela, Brazil, Chili, and Bolivia; silver also by Chili and La Plata; copper from Chili, is sent to Swansea for smelting, although Chili has coal. Brazil produces iron and nitre abundantly, with immense quantities of salt.

The precious metals are thus seen to be the principal produce of the mines of South America. The mountains everywhere are metalliferous; but wasteful working, difficult transport, the deficiency of fuel, and the distracted state of most of the mining regions, have combined to lessen the value of the mines. California produces more gold now than any other part of America. Gold and silver mines abound in the Andes. Chili produces more gold than silver; the former being found in every rock, and among the sands of its many mountain streams; but, generally, silver is most prevalent in the Andes, as gold is in the sierras of Mexico and California. The far-famed silver mine of Potosi, in Bolivia, has yielded—since its opening—in the three cen-

turies a greater amount of silver than all the mines of Peru, and nearly half the value of the produce of all the mines of Mexico.

The gold of Brazil is extensively dispersed among its mountains, but the yield is small, and silver ore has not been met with. This country contains diamonds and other precious stones to a greater degree than any other: and, with Hindostan, Borneo, and South Africa, completes the list of places productive of the diamond.

In common minerals, South America is deficient; nitre and salt, as already mentioned, being the chief products. Among the mineral products, though of animal origin, of South America, must be named the *guano,* or more or less fossilised droppings of the sea-birds of the Peruvian islands; to which rich fertiliser the agriculture of our own country is perhaps more indebted than to any other artificial manure. Its importance as a source of revenue in the place of its origin may be gathered from the fact, that disputes connected therewith were one of the main causes of the disastrous war between Chili and Peru.

**Animal Produce.**—The indigenous fauna of America is more limited than that of the Old World, and especially so in the larger species of animals. Besides being few in number, and small in size, the mammals are mostly of peculiar structure. The llama was the only domestic animal found upon the continent by the first European settlers. In the northern regions, where America all but meets the Old World in the narrow breadth of Behring's Straits, the reindeer, the elk, the bear, the fox, the beaver, and the glutton are common to both hemispheres. Hunting and trapping the fur-bearing animals has been hitherto the almost exclusive vocation of the sparse population of the Hudson's Bay territories. The marine mammals—the seal, the walrus, and the whale, which furnish us with skins, oil, whalebone,

and ivory—are identical with those throughout the arctic and sub-arctic zones.

Further south, the American bison or buffalo, hunted for its tongue chiefly, overruns Canada and the Western States, herding in the prairies and savannas of the Mississippi river, where likewise deer are extremely numerous. Great flocks of the large-horned or wild mountain sheep live among the Rocky Mountains. Many of the quadrupeds of Mexico are peculiar to the country, but none of them are of any important economic value.

Birds are numerous and of many varieties. America is the native home of the turkey, two or three species of which are found in the forests of North and Central America. Tropical America has curassows, and guans, birds equally large, and as delicate of flesh. The other birds of use for food, or for industrial purposes, are closely related to those of the Old World. The arctic shores are covered with sea-fowl, as in Europe. The eagle and the vulture live in the mountains. Passenger pigeons darken the sky by the immensity of their numbers. The nandu of La Plata and the rhea, a smaller bird of Patagonia, represent, in America, the ostrich, by which name, too, they are sometimes called.

Many of the American birds are valued only for the brilliancy of their colours. The delicate humming-birds range from Alaska southwards to Cape Horn. Beautiful parrots likewise have a large southerly range, though not extending more than a few degrees beyond the Tropic of Cancer. Amongst the American reptiles several are turned to useful account. Turtles abound in the enclosed seas of Central America, and upon the shores of the West Indian islands, affording one of the choicest forms of animal food: and also along the Pacific coast, where one species of turtle supplies the beautiful substance called tortoise-shell. An extraordinary fish-like reptile, caught only in the Mexican

lakes, and called the *axolotl*, is eaten as an exceeding delicacy.

Edible fishes are abundant, both of the sea and the river species. Exhaustless shoals of cod feed on the banks east of Cape Breton and of Newfoundland. Varieties of the herring also fill the inlets, and are caught in myriads.

Of minor food-products from the animal kingdom, oysters are so plentiful, that dinner in the United States is never complete without them in one or more fashions of cooking. Oyster banks, along the low mangrove swamps of the Southern States, form natural embankments against the sea. Along the shores of California, pearl oysters are found. In the class of insects, the cochineal is indigenous, and was brought from Mexico, whence we still get large supplies, as well also from Central America, which even now competes with the produce of the warm parts of Europe. Bees, introduced from Europe, supply, in return, large stores of honey.

It is not the native animal produce, but the produce of animals introduced by Europeans, that distinguishes America in the present day. The domestic varieties of Europe have found the conditions of increase so favourable, that horses, cattle, and swine have returned to a state of nature, and swarm over the boundless plains, or through the forests both of the North and the South. The Indians of the North, who have become fearless riders, hunt the bison on horseback. In tropical America the mule is used as a beast of burden, and the numbers of this sure-footed animal—a compromise between the beautiful Spanish wild ass and the horse—it is hardly possible to estimate.

With the knowledge of these resources, we are able to name the animal produce of which America will have a surplus for interchange. From our own possessions and the United States, cheese and provisions, as exports,

increase in quality and quantity every year. Hides, tallow, and wool are also exported. Furs from the extreme north, and fish, both dried and pickled, to which we may add the produce of the whale fishery, are, and will remain, constituents of the grand commerce of North America.

South America, less advanced, sends us chinchilla furs from Venezuela, and hides, tallow, horsehair, horns, bones, and wool from the animals that bound over the country between the llanos of the Orinoco and the shingly steppes of Patagonia. Means are being taken to export live cattle as well as the flesh of the oxen in a fresh state to Europe, but the success as yet has been very partial. Nevertheless the exports of frozen carcases, potted and concentrated meats, dried turtle, and lobsters, have met with European favour and assumed profitable proportions.

### Vegetable Produce.

The flora of a continent, the distinguishing physical features of which are vast lowlands, in temperate and tropical regions, amidst heat and moisture, may be determined beforehand as diversified and exuberant. In tropical America vegetation reaches its utmost limits of luxuriance. Nevertheless, before the introduction of plants from Europe, the productions of the continent were peculiar, and comparatively few of them known to be useful to man. As in the case of animals, America has given little and received much. The plants introduced have spread widely, and furnish limitless stores of food. Nearly all the economic plants of Europe are now grown in the cleared parts of the United States, and the tropical zone has been enriched with many plants from corresponding parts of Africa and Asia.

**Indigenous Produce.**—Maize is the only native representative of the cerealia; and manioc, from which cassava bread and tapioca are prepared, takes the place in South America that rice assumes in India. Allspice or pimento,

the most important native pungent condiment, and akin to the various combined spices of the East, grows only in Jamaica and some other of the West India Islands. Cocoa and maté, or Paraguay tea, are the beverages of South America, in lieu of coffee and tea. Plantains and bananas are the characteristic fruits. Cinchona bark—from which the invaluable drug quinine is extracted—the ipecacuanha of Brazil, the sarsaparillas of tropical America, and the jalap of Mexico, have no representatives elsewhere. The most remarkable native products are, without doubt, first, the potato—spread from Chili throughout the world; secondly, tobacco—now grown in several countries, but brought to perfection only in its native soil of Cuba, the capital of which, Havannah, gives the name descriptive of the best leaf. Cigars are, notwithstanding, made from leaves grown in the Southern States and sent to Havannah for manufacture, in order to obtain an extra price. The Havannah plantations could not supply a tenth of the demand for *real* Havannah cigars, which are, not unfrequently, better made in England, from equally good leaf, shipped to Cuba, and re-entered, as the genuine and choicest brands.

Although the indigenous plants used for food are few, compensation is given in the weight of their produce. In Europe, large spaces are covered with food-grasses and other plants, for the sustenance of the inhabitants. In America, small tracts of maize, manioc, and plantain will produce enough food for large numbers of people. As a consequence, in South and Central America, where these plants flourish, the country remains in its wild, natural state, even in the vicinity of large towns, the inhabitants not being obliged to extend their cultivation. The vigorous races of North America, however, cultivate wheat, barley, and oats, and the tropical rice, all of which, in their respective zones, flourish abundantly. Bread-fruit has been

introduced, and pine-apples have become so plentiful that they grow in the fields in the West Indies as turnips with us: many shiploads reach our markets, in the season, at so moderate a cost as to bring this chief among choice fruits within the reach of the poor.

Coffee and sugar have proved their adaptation to the American tropics, the crops of both being enormous. The East Indian spices also grow in the West Indian Islands, although not in the same perfection. Cotton has found the foreign conditions of growth in America superior to those of its native soil, and its spread is almost beyond belief. The American crops transcend those of all the rest of the world.

Besides these vegetable products that appertain to food and clothing, America possesses peculiar forest growths. At the head of these we must place the mahogany tree, the beautiful colour and grain of which, as well as its durability, placed it on its discovery in the highest rank amongst cabinet timber. Logwood, quer-citron, and Nicaragua woods are well known as yielding valuable dyes.

The tendency to efflorescence in the trees of America, and the floral beauty of many of the shrubs and annuals have encouraged their diffusion through Europe. Our gardens owe to this source the grand flowering rhododendrons and the magnolia. The American aloe and the cactus have found a congenial region round the Mediterranean, where they exhibit all their native vigour. The dahlia, fuchsia, nasturtium, and passion-flower, all had a western origin. Many other trees and plants, valued for their foliage or floral beauty, from the colder parts of America, where flowers are less profuse, adorn the parks and pleasure-grounds of Europe.

## Vegetable Produce according to the Floral Zones.

Our previous knowledge of the zones, as applied to the Old World, combined with the general knowledge gained

of the produce of the New World, prepares us for a brief description of this division of the subject.

The boreal region, or climate of mosses and berries, is like that of Lapland. The arborescent forms, at the extreme limit of the zone, are a few stunted birches, willows, and junipers; otherwise, the ground is covered with a thick growth of lichen and moss, which defies the cold and overpowers other vegetation. Towards the southern border extensive forests, which extend into the next climatic zone, characterise the country.

The region of European grain and forest trees is bounded southwards by the line of vine culture and the growth of maize. Canada and the northern United States are included within it. Peculiar species of oak, beech, and numerous other forest trees, orchard fruits and nuts, the cereals, including in the south, maize, the common fibres, and, to some extent, tobacco, all flourish in this zone; also woods of great value and beauty, the bird's-eye maple and the mast pine being the chief varieties, noted for the delicacy of their grain and texture. A peculiarity of the North American forests is that one description of tree prevails on each variety of soil, evidence of which is given in the descriptive names of oak lands, chestnut lands, pine barrens, and cypress swamps.

The sugar maple supplies from its sap much of the sugar used in Canada and in the United States, and the produce might be indefinitely increased. Maple sugar is especially used in confectionery and sweetmeats, of which the Canadians consume large quantities, possessing as it does less cloying properties than such as are made from cane sugar. Imported cane sugar is, all the same, in common request, except in the extreme backwoods. Vast orchards of fruit spread over Canada and the United States, whence we derive yearly increasing supplies of apples,

barrelled fresh, boiled in tins, and dried in chips, or rings. Tinned peaches, apricots, and tomatoes are placed within our reach from the same sources, where they are so abundant as often to become the food of the domestic swine.

Potash, principally from the beech, as well as the turpentines in the various forms of crude pitch, tar, resin, and refined spirits, are forest products, in quantities corresponding with the endless sources of supply, but identical with those of Europe. Trenching on the warmer regions, the myrtle wax-tree (*Myrica cerifera*) abounds, and supplies in its seeds a dry and brittle wax, of excellent quality and large amount.

The region of wheat and tropical grains is productive also of maize and rice, the vine, citron, and melon, as in the Old World. The indigenous fox-grape has a most offensive taste and odour, whence its name. Grapes, pumpkins, melons, oranges and lemons, are a distinguishing feature, especially of Texas and Florida, but in reference to America at large, perhaps cotton and tobacco would be more descriptive of the zone.

The mountains of Mexico, separating that country from the rest of the region, and raising it on a table-land 7000 to 9000 feet above the sea, make it the botanical centre of a flora peculiarly its own, including the cochineal-cactus and other plants. On the east, the Alleghanies separate the fertile valley of the Mississippi from the poorer soil and barren swamps lying between these mountains and the Atlantic shore.

The true tropical parts of America comprehend the central states, that is, Mexico, the republics of Central America, and two-thirds of the southern continent. All the useful food plants of India are diffused throughout this zone, besides a rich vegetation of its own. Tropical grains and manioc, ginger and other spices, coffee, sugar-

cane, and sweet fruits, gourds and pine-apple, cocoa-nut and other palms, tobacco, drugs, dyes, and timber are amongst the contributions that Central America offers for man's service. Tree ferns are common, though not utilised as in New Zealand, where the Maories make their bread of the farina contained in the stems. Tropical South America adds other gifts. The palms are in great variety. Besides the cocoa-palm, there are the cabbage, the fan, and the oil-palms, the coquilla and the vegetable ivory. Bread-fruit trees and cow-trees, producing milk, are numerous; and from allied plants, characterised by their milky juices (*Euphorbiaceæ*) our chief supplies of caoutchouc are procured. Other products of an important nature, such as the cacao, indigenous to the country, have already been mentioned.

The flora of the Andes ranges vertically through every climatic zone, beginning with the plantains and palms at their torrid base, and passing through the intermediate phases of climate, to the silent and frozen mountain summits, devoid of life.

South of the Tropic of Capricorn the products of the torrid and temperate zones interfuse. No rice is seen, but maize grows with wheat and barley, and palms and the mulberry flourish together; tobacco, hemp, and flax ripen by the side of the melon, the lime, and the olive. Chili produces a surplus of wheat for exportation. Brazil is in many parts still covered with forests almost impenetrable. From them rosewood and dye-woods are obtained.

Beyond 40° south latitude there is little cultivation, and vegetation diminishes rapidly. The climate would admit of grain, but, except in a few parts, the soil is a shingly desert upon which little will grow that can be turned to any economic use. The peninsula tapers to a point which trends southwards to the latitude of 55°, and the last ten degrees are utterly cold and desolate.

# CHAPTER XII.

## NATURE AND MAN AS AGENTS OF CHANGE.

Summary of Former Chapters—Contrast of Old and New Worlds as to Physical Conditions—Geological Evidence of Change of Climate and Produce—Variations of Orbit—Man Subject to these Laws—Their Harmony Illustrated.

We have now traced the relation throughout the earth: (1) between geological conditions and mineral wealth; (2) between climate and soil on the one hand, and organic forms on the other. We have seen how contour, vertical relief, and other physical features modify climate and soil, and consequently animal and vegetable life. We have also been led to observe that the study of the geology of any region is auxiliary to a knowledge of its flora and fauna.

The great mountain ridge of the New World presents no such barrier between the equator and the poles, as the Himalayas and their adjuncts offer in the Old World. The dispersion of plants and animals is therefore limited by more elastic conditions, and the separation of zones is marked by less decided lines. The tropical waters of the Caribbean Sea divide America into a northern and southern continent, closely corresponding, each division being related to the other by bands of analogous climate and produce, which are but portions of bands similarly crossing the Old World, and encircling the earth.

There is abundant evidence to prove that the zones of the earth's surface have been subject to repeated changes, the agents of which have been Nature and, involuntarily,

man. The great plains of America are geologically recent. In the arctic regions coal-beds are found, the fossil flora of which, composed of a preponderance of Conifera, indicates a climate corresponding to that of mid-Europe, and proves that in the long cycles of the earth's physical history and its successive oscillations, the poles, whose frosts we often call eternal, have aforetime and more than once borne excess of heat.

The vibrations of the earth in reference to its axis, slow though they be, are persistent, and although intervals of thousands of years are required to make perceptible comparisons, yet the equilibrium of our planet goes through a long period of unresting poise. At the present time the arctic coasts are rising, and the bed of the Pacific is sinking in obedience, it is believed, to the law requiring the centre of gravity of the earth's mass to be maintained by the mobility of the ocean. The nature of the changes thus brought about may be illustrated by a supposition easy to comprehend. If the relation between America and the Atlantic were gradually to alter so that the sea-level rose 300 feet, the llanos of the Orinoco would be covered. If it were 1100 the sea would wash the base of the Andes, and only leave those mountains and the highlands of Venezuela, the Guianas, and Brazil above the waves.

Man finds work ever ready to his hand. By diligent labour, guided by intelligence, he can modify many of the aspects of Nature, and obtain from her bounty an indefinite increase of enjoyment. He cannot alter the past or arrest the future, but he may shape the issues of both to his advantage.

What are the limits of our power, and how may we best use it to promote well-being? Such are the inquiries which the course of study we have pursued should aid us to answer.

Nothing more beautifully shows the harmony of natural laws than the modifications of the forms of life by the change of conditions. We fell a forest, and the timid browsers lose their shelter and food and disappear; the wild beast is deprived of its covert and prey, and is seen no more; birds, too, migrate to districts where insects and berries abound. We cultivate a plain, and the grub of the cockchafer begins its havoc among the corn roots, and the earthworm its system of under tillage, till, attracted by their prevalence, the familiar forms of our common birds are seen, and the balance of vegetable and animal life is restored. The sparrow was unknown in Russia last century; but the rapid progress of corn culture, the sign of civilised progress, has emboldened this bird to spread over the empire, even as far as Siberia. Partridges, again, whose food is found in the corn-fields of England and France, have recognised the high husbandry of Scotland, and are met with at Inverness, the limit of British wheat growth. Food, therefore, becomes the link between the flora and fauna of the climatic zones.

Many illustrations might be submitted of the effects of human agency in modifying the aspects of Nature, sometimes intentionally produced, sometimes otherwise. Mr. Grierson, at the meeting of the British Association in 1866, read a paper referring to the destruction of plantations at Drumlanrig in Dumfriesshire, by the voles, commonly called rats, which are the pest of Sweden. They appear to be migratory in their habits, and occasionally increase in myriads. From the recent slaughter of rapacious birds, such as owls, hawks, and eagles, which Nature has appointed to bound the unlimited fecundity of the rodentia, the voles have found a safe field for action. They principally destroy the young oak and ash, gnawing a ring of bark near the roots and beneath the grass, the trees being unable to resist such attacks until after at least twelve years' growth. In like manner regions

have been rendered bare by the introduction of goats, which destroy the mature trees by devouring the bark, and arrest the renewal of young plants by browsing on the seedlings. The presence of swine, on the contrary, tends to the permanence of forests. The myriads of swine swarming in the woods of Russia and North America render material service to vegetation, by grubbling up the soil for the fallen mast on which they feed, and thereby letting in air and moisture for the sustenance of the trees. Pigs are often penned round our orchard trees for a similar purpose and for their manure, where a few goats admitted would cause utter destruction.

By our acquaintance with the *facies*, or landscape features, of a floral region, we are able to judge when and where we can with profit introduce or transfer the plants of one country or hemisphere to another. Thus it is that we have spread the useful food plants, fruits, fibres, and timbers, or strewn our colonies with wild flowers, associated with the thoughts of home.

The vegetable kingdom is full of striking examples. The fruits of Europe, most of Asiatic origin, were removed westward in the same zone, and subsequently to the New World. The diffusion has been carried still further into the zones of the southern hemisphere. The vine now flourishes in South Africa and Australia. Grains, either tropical or northern, have gone with man into every habitable clime. Maize has enlarged its area in the three continents of the East, and rice has spread almost as widely in the West. We owe to Chili the potato, which has lightened existence to extra millions of mankind. The pine-apple was a native of the Bahamas and Bermudas, and is now plentiful round the Mediterranean. Tobacco, unknown till the sixteenth century, belts both sides of the equator far beyond the tropics. Cloves and pepper are acclimated in each of

the Indies, though native only to the East. Coffee also, indigenous to Arabia or Abyssinia, has sped through the tropical zone. Thus also with the fauna, we have aided Nature in the distribution of her productions, enriching each zone with the representative species of its corresponding zone. The wild horses and cattle of South America seem destined to exterminate the native llama. The English sheep in Australia have driven the kangaroo inland, and threaten its extinction. The effect of introducing our domestic animals into other countries has been to increase our resources for food and clothing, to add to wealth, and to the duration of human life.

Nature has arranged the climatic zones in a manner whose simplicity and unity of working fill our minds with an exalted pleasure. Oceans come between the continents, and obstruct the passage of certain forms of life; yet many thousands of miles distant the conditions of being are only modified, and we meet, indeed, not the same species, but representative ones, whether of animals or plants. The animals of the Old World, both beneficial and noxious, have indigenous species to represent them in the economy of Nature in America. The lion of Asia and Africa is represented by the puma, and the jaguar is known as the American tiger. The llama and alpaca, in like manner, take the place of the camel, horse, and ass. Ostriches, coursing with the fleetness of the wind over the Arabian and African deserts, are represented on the South American plains by the rhea, and in Australia by the emeu. The Arctic grebes, whose feathered skins are so much prized for warm winter trimmings, are matched by the penguin of the Antarctic. The fishes, reptiles, birds, and mammals of the East Indies, find representative species in the West Indies. The gavial of the Ganges and the crocodile of the Nile are genera allied with the alligator of the Mississippi and

the cayman of South America. Australian rivers have the analogous reptiles.

A similar divergence in unity is observed in the vegeta tion. The landscape features of Europe and America in the same zone are different in the midst of strong resemblances. There is an impression of immensity in an American forest which a European one cannot convey. There are oaks, beeches, maples, and wood-nuts, but differing both in magnitude and species. So also is it with the exuberant plains of India and the selvas of the Amazons, both rich in palms; the sago and areca against the coquilla and vegetable ivory; and neither region second to the other. Similarly the three peninsulas of America, Africa, and Australia, regarded as a prolongation of Asia, have harsh leafless plants, as the gum-trees (*Eucalyptus*) and the spurges (*Euphorbiaceæ*). Lastly, to contrast antipodal zones, New Zealand and England possess in common not a plant identically the same, yet the trees in the one country find their counterpart species in those of the other.

# PART II.

## THE COMMERCIAL PRODUCTS OF THE VEGETABLE KINGDOM.

### *INTRODUCTION.*

PLANTS are merely earth, water, and air, transmuted. The mineral or inorganic kingdom is in a state of constant change. Chemical, igneous, electrical, aerial, and aqueous forces are ever active in modifying physical conditions. Beyond these forces there is the vital principle which manifests its energy in wondrous ways. Life has been defined as *the state of action between organised bodies, whether vegetable or animal*, and their environment. Plants absorb and feed upon the carbonic acid gas of the atmosphere, supplied thereto by the respiration of animals. Plants, likewise, exhale oxygen, the life-sustaining element of the animal world. Plants and animals thus combine to maintain a balance of purity in the ocean of air in which man lives and moves and has his being. Plants, further, elaborate from inorganic substances those nutrient principles which constitute the food of animals, whose decomposed constituents, in turn, nourish vegetable life. Animals and plants, infinite in diversity, act and re-act and reciprocally sustain each other.

Some plants are especially useful to man as sources of food, clothing, shelter, medicine, and other necessaries and comforts. Such, for example, are cereals and fruits, fibres, building materials, barks, gums, resins, balsams, tanning substances, dyes, oils, and perfumes. These products are found in different climatic regions according to their powers of adaptation to the surrounding conditions.

One is led to ask the use of noxious weeds and venomous insects—seemingly baleful examples of life. The more we inquire, however, into the operations of Nature, the more clearly we perceive that nothing exists in vain. Human intelligence has usefully applied even poisons from the vegetable kingdom. Such are some curative drugs, and also edible substances. Tapioca comes from a root, (Manihot) whose juices are used by the American Indians to poison the barbs of their murderous arrows and spears. Our common potato belongs to the deadly nightshade tribe, and, even as cultivated, retains in its apple or fruit its fatal properties. Parsley, celery, and other vegetable foods have been rendered innocuous by art. Awaiting our intelligence to discern all their properties, there is an indefinite number of so-regarded noxious plants, to be reduced to human service. Of the rest, although we may never seek for, or succeed in finding the means to utilise their properties, they will persistently perform their functions of maintaining the balance between animal and vegetable life.

Various interesting thoughts may arise in the mind of the young merchant relative to these facts. What are the conditions under which useful plants flourish? What economic substances do they supply, and what purposes do they subserve? What countries resemble the native habitat of special plants closely enough for hopeful experiments in extending their culture? Such inquiries must obviously open a wide field of research. They are now carried on,

by commercial naturalists, through a world-wide correspondence and reciprocal transfers of plants to a degree to constitute a high-class division of labour, and society benefits every year by an enlarged trade and new additions to the raw materials of our manufactures. Numerous as are the vegetable products hitherto discovered capable of utilisation, they are few contrasted with the manifold stores of nature.

The most valuable of the economic plants may be divided into two groups:—

I. Food Plants.

II. Industrial and Medicinal Plants.

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## SECTION I.—FOOD PLANTS.

### I. Farinaceous Plants.

The grasses (natural order, *Graminaceæ*) constitute one of the most widely-distributed of the natural families of plants, appearing in temperate climates in numbers so vast that they form the mass of the verdure which covers the landscape. The grasses of tropical climates are much loftier than those of the temperate zones, less gregarious, and more tufted. We give the first consideration to the Cerealia, or corn plants, the grain of which contains an abundant farinaceous albumen, capable under cultivation of improvement in quantity and quality. The Cerealia have been cultivated from the remotest antiquity, and were thought by the ancients to be the gift of the goddess Ceres. Their native country is unknown, and they have been so changed by cultivation, that we are ignorant, except in one or two plants, of the wild stock from which they are lineally descended. The Cerealia of temperate

climates include the European cultivated grasses, wheat, oats, barley, and rye; while maize and rice are the chief cereals of the tropics.

### *A.—The Cerealia of Temperate Climates.*

WHEAT (*Triticum vulgare*, L.).—Wheat is the chief grain of temperate and sub-temperate climates. Its geographical range extends from 30° to 60° N. lat., and 30° to 40° S. lat., in the eastern continent, and Australia. Along the Atlantic portions of the western continent the wheat region embraces the tract lying between 30° and 50° N. lat. In the tropics, wheat is cultivated only in mountainous districts, where the land is sufficiently elevated to be of the proper temperature. It is estimated that in Great Britain 5,000,000 acres are annually covered with this grain.

Wheat is imported into the United Kingdom from almost all parts of the globe. We get soft, red, and white wheat from Austria: Spanish wheat from Bilbao; Saxanka wheat from St. Petersburg; much from South Australia; we also import largely from the United States, California, the East Indies, and Hindostan. The finest kind of European wheat is from Dantzic, the grain being large, white, and very thin-skinned. The largest amounts were formerly received from the southern parts of Russia, from Prussia, and from France, but the trade does not compare with that of the New World and our Eastern Dependencies. A hard Italian wheat is much sought for maccaroni and vermicelli.

Wheats divide into white and red, hard and soft, each quality requiring its special conditions of climate to come to the highest perfection. The value of wheat is estimated from the colour and form of the grain, its weight, dryness,

and flavour. The weight is an essential point. Hard wheat is grown in warm climates, such as those of Algeria, Southern Europe, India, and Australia. Hard wheat contains much nutritive matter, and the flour therefrom is in demand among confectioners. Red wheat is an intermediate kind between the hard and soft.

Wheat was formerly sown broadcast, that is, thrown from the hand of the sower over soil previously prepared by the plough. This is the most ancient mode. In modern times the plan of drilling or dibbling has been adopted; that is, depositing the seed in holes, formed in straight furrows at regular intervals.

When wheat is crushed between the stones of the mill, it is separated into two parts, the bran and the flour. The bran is the outside harder part or tunic of the grain, which, intermingled with the flour, darkens its colour, and is generally sifted or bolted out to a greater or less extent. Bran is used for fattening the stock on the farm, and is of some commercial value in tanning, calico printing, and for filling dolls and cushions. The finest kind of bran is called middlings. Pollard is a coarse product of wheat from the mill, but finer than bran. The average weight of a bushel of wheat is about sixty pounds, yielding forty-seven pounds of flour and eleven pounds of pollard, two parts being lost in grinding and dressing.

The whole meal, or the mixture of flour and bran, is as nutritious as the grain itself; and as bran is an alimentary substance, and equal to one-fourth the weight of the whole grain, by its separation much waste of wholesome food is caused. The great importance attached to bread perfectly white arises from prejudice. Brown bread, from the whole meal, is not merely more economical but contains the most nutriment.

Flour is largely imported from California and other parts of the United States. The quality of flour depends upon

the skill and care with which it is milled and prepared, as well as upon the kind of wheat from which it is produced. In France, the finest used for fancy bread is called *gruau*, and with us *pastry whites*.

Vienna flour is esteemed throughout Europe.

In the United States, different trade terms are employed for flour. Thus *Common State* is the designation of flour from spring wheat with only the bran bolted out. *Extra flour* is made from the best quality of red winter or low white wheat, with the fine flour and middlings bolted out. *Double extra* is the choicest flour made from the best white wheat. *Extra State* is from spring wheat bolted clear. *Fancy* is a kind of flour, made of a mixture of red, white, and spring wheat bolted clear.

Good flour, when pressed in the hand, should pack in a ball and not fall in powder. A portion thrown against a smooth vertical wall should mass in a lump and not scatter in a fine white dust. When wet and kneaded, it ought to work dry and elastic, not soft and clammy. Its colour should be pure white without a bluish tinge. No black specks, however minute, should be found by the closest examination. A slight yellow colour is not a bad sign.

OATS (*Avena sativa*, L.).—The oat is the hardiest of all the cereal grains, and one of the most elegant of grasses. It can be cultivated in countries too cold for the growth of wheat and barley. Its adaptability to climate is so great that it is cultivated in Bengal as low as 25° N. lat., but it refuses to yield profitable crops as we approach the equator. The oat is cultivated in England, principally in the north and north-eastern counties, and in most parts of Wales and Scotland. It grows luxuriantly in Australia, in Northern and Central Asia, in South America, and over the whole of the cultivated districts of North America.

The meal of this grain is remarkable for its richness in

gluten, and for containing more fatty matter than any other of the cereals. To these two circumstances it owes its nutritious and wholesome character. It is, therefore, very suitable, and much in use, as an article of diet for invalids. The variety called the potato oat is a great favourite in Scotland, and is almost the only kind now cultivated there. Oatmeal forms a very considerable portion of the daily food of the Scotch, and oat-cakes are much eaten in the northern counties of England.

We export no oats, as our domestic consumption is far more than equal to the amount grown. The crop of this grain annually raised in the United Kingdom is less than half that of wheat. We receive large cargoes of oats from foreign parts, the largest quantities coming from Russia, Sweden, and British North America.

The use of the oat is very ancient. It is not mentioned in the Bible, but it is alluded to by the Greek and Roman writers Dioscorides and Pliny. Caligula the tyrant is said to have fed his horses with gilded oats; probably an allusion to the colour of the grain.

BARLEY (*Hordeum distichon*, L.).—This grain is one of the staple crops of northern Europe and Asia, growing as far north of the equator as 70°, and as far south of it as 42°, in favourable seasons and situations. In the New World its growth is chiefly confined to Mexico, the middle, western, and northern States, and Canada. In Asia, it is cultivated in the Himalayas and Thibet, replacing wheat in many districts, and producing admirable flour.

Barley is chiefly used for malting and distilling purposes, in making beer and spirits. When the outer coat of this grain is removed, it is called Pearl Barley, and in this form it is valuable for thickening broths and soups. Barley water is a mucilaginous drink for invalids, made by boiling pearl barley.

We import many million quarters of barley, our chief sources of supply being Denmark, Germany, France, and European Turkey.

Barley is a very ancient article of human food. It is mentioned in the Bible in the Book of Exodus. It has been cultivated in Egypt and Syria for more than 3000 years. Pliny calls barley the most ancient food of man. It requires very little dressing when sent to the mill, having no husk, and consequently, no bran. It may be eaten without any other preparation than boiling.

RYE (*Secale cereale*, L.).—This is a highly nutritious grain, but not much raised in this country, except as green fodder for cattle. In Bohemia and most parts of Germany, however, rye forms the principal crop. It is also much cultivated in the north of Europe, and in Flanders, where, mixed with wheat, and sometimes with barley, it forms one of the means of subsistence. The peasantry of Sweden live very generally on rye cakes. Geographically the diffusion of rye and barley is pretty much the same, as these plants generally associate together, growing in similar soils and situations.

Rye-straw is useless as fodder for cattle, but forms excellent thatching material and a superior article for stuffing horse-collars, so that it is in favour with saddlers; and our annual imports amount to some hundred thousands of hundredweights.

Rye is much infested by a very poisonous fungus. When attacked in this manner, it is called in England, "horned rye," and in France *ergot*, from a fancied resemblance to a cock's spur. The poison affects not only human beings, but swine and poultry, eating it, die miserably in strong convulsions and with mortifying ulcers; and insects settling on it are killed. Ergot of rye is, in the hands of the skilful physician, a remedial agent.

The principal granaries of Europe are Hungary, Russia, Moldavia, and Wallachia; and the chief ports for the exportation of grain, Archangel, Cronstadt, Riga, Königsberg, Danzig, Stettin, Rostock, and Kiel, in the north; Taganrog, Odessa, Galatz, the Danube, and Trieste in the south. Large flour mills have been erected at Mayence on the Rhine, which is now a very important place for this branch of commerce.

### *B.—The Cerealia of Warm Climates.*

RICE (*Oryza sativa*, L.).—This grass is a native of the East Indies, whence it has spread to all the warm parts of Asia, Africa, and America. It is a marsh plant, and grows like the oat, the grain hanging from the thin, hair-like pedicles, forming a loose panicle. Rice is cultivated throughout the torrid zone, wherever there is a supply of water. It matures on the eastern continent as high as 45° N. latitude, and as low as 38° S. latitude. Its cultivation is generally within these limits. Our chief supplies come from the "rice ports" of Bangkok, Akyab, and Moulmein.

The rice from the Southern States of America is the best, being sweeter, larger, and better coloured than that from Asia, where its cultivation is not so well managed, except indeed Bengal rice, which now nearly equals that growing in the Carolinas. South Carolina produces the best American rice, and Patna the best East Indian variety; but many of the parcels, commercially called Carolina, are derived from Berbice. Carolina rice possesses a long brilliant grain and is carefully cleaned. For alimentary purposes it is preferred before all other kinds, and attempts have been made to introduce its choice seed into India. Java rice is inferior to that of Bengal or Carolina, from the careless mode in which it is got ready for the market. In

husking, the grain is much broken, and, from negligent drying, it quickly imbibes moisture and becomes mildewed, when it is subject to the attacks of insects and decays. The varieties of rice are innumerable. Commercially they are classed as table rice, cargo rice, and white rice. All the different kinds of Carolina rice resolve into the upland or mountain rice and the lowland or swamp rice. Excellent rice is also grown in the Spanish provinces of Andalusia, Valencia, and Catalonia, as well as in the marshes of Upper Italy, especially Lombardy and Venice, and in the plains of Milan, Mantua, Verona, Parma, and Modena, along the River Po.

Rice does not contain half as much gluten as wheat, and will not make a loaf, but has one-fourth more starch in its composition; hence it is chosen by our starch-makers both for its cheapness and its larger yield. A coloured rice shipped from Madras is imported almost exclusively for starch. Of all the cereals, rice is the most compact, seldom weighing less than 65 lbs. to the bushel.

Immense quantities of rice are consumed in England, in the form of puddings and confectionery. The straw is plaited for bonnets.

Rice, although regarded by us more as a cheap luxury than a necessary article of food, forms the chief subsistence of the Hindoos, Chinese, Japanese, and other eastern nations. The Burmese and Siamese are the greatest consumers of this grain. A Malay labourer requires 56 lbs. monthly, but a Burmese or Siamese 64 lbs. The South Carolina people do not consume much rice. They raise it principally to supply the foreign demand—the swamps of that state, both those which are occasioned by the periodical visit of the tides, and those which are caused by the inland flooding of the rivers—being well suited to its production. The mountain rices of India are grown without irrigation,

at elevations of 3000 to 6000 feet above the level of the sea; the dampness of the summer months compensating for the want of artificial moisture.

Rice in the husk is called by its Indian name "Paddy." Before it can be used for food this husk must be removed; this is done in India amongst the poorer people by rubbing the grain between flat stones, and winnowing or blowing the husks away. Paddy is now imported into the United Kingdom in preference to shelled rice; there is less loss by waste, and the importers avoid several charges on rice prepared for use. Our machinery is better adapted for removing the husk than the methods employed in the countries where rice is produced. Unhusked rice or paddy may be kept sound for many years. Good judges, in fact, have a preference for rice a year old.

Rice-paper, so named from its appearance, is not manufactured from this grain, but is the pith of a shrub called by the Chinese "Taccada," and by botanists *Aralia papyrifera*, L. The pith, carefully removed from the stem of the plant, is first cut spirally with a sharp knife, then unrolled, spread out, and pressed flat. This paper is much used by the Chinese for water-colour paintings of insects and flowers.

The cultivation of rice dates from the oldest periods of which we have any record. Ecclesiastes xi. 1, "Cast thy bread upon the waters, for thou shalt find it after many days," evidently applies to rice, which in Egypt is always sown whilst the waters of the Nile cover the land, the retreating floods leaving a rich deposit of thick alluvial silt, in which the rice vegetates luxuriantly. A spirituous liquor (*arrack*) is distilled from rice.

MAIZE, or INDIAN CORN (*Zea Mays*, L.).—This plant has a strong reedy-jointed stem, as thick as a broom handle, with large alternate leaves springing from each joint. In

favourable situations the stem attains a height of from seven to ten feet, and terminates in a large compound panicle of male flowers called the *tassel.* The female flowers are situated below the male, and spring from the sides of the stem. They consist of ten or more rows of grains or caryopses, situated on the surface of a thick cylindrical pithy axis or stem called the *cob*, from eight to ten inches in length. From each of these grains proceeds a long hairy filament; the whole cob being enveloped by several layers of thin leaves, forming the husk or wrapper. The filaments of the individual grains hang together in a thick cluster out of the husk, and are called the *silk.* The filaments receive the pollen or fertilising matter from the anthers of the *tassel;* a fact easily proved by cutting off the tassel, when the ears prove abortive. After fertilisation, both tassel and silk dry up. This plant when grown up to some height usually sends out, from the lower joints of its stem, several suckers which help to maintain its upright position, acting as props or buttresses.

Maize may be raised on the American continent as far to the north and south of the equator as the fortieth parallels of latitude, whilst in Europe its geographical range extends even to 50° and 52°.

Naturalists are at no loss to determine the native country of maize, which is undoubtedly America, as the Indians throughout the continent were engaged in its cultivation when the New World was first discovered. It now forms the staple grain crop of the United States and Mexico. Since the discovery of America, maize has been introduced into the Old World, and is now grown in Hungary, Transylvania, Moldavia, and Wallachia. From these countries large quantities are annually sent down the Danube, *viâ* the Wallachian port and fortress of Galatz, into the Mediterranean as far as Malta and Trieste. Maize is also

grown in the countries around the Mediterranean, and in Southern Germany. It is raised in India and the East Indies, and has been successfully cultivated in Australia. Maize is a striking example of the power of plants to wander, through the whole climatal zone suited to their growth. Primarily a gift from the New World in exchange for rice from the Old, it has travelled to the heart of Africa, and has reached an importance only next to rice, as the sustenance of divers races, as far as China and Japan.

Like the other cereals, maize may be reduced to meal, the coat of the grain or bran remaining mixed with the flour. Owing to its deficiency in gluten, it is not used for making bread. In the United States, it is made into cakes, and eaten under the name of "corn bread," familiarly known as "Johnny cake." In this country it is not regarded with favour as human food, although it is sweet and nutritious. We import it from America for feeding and fattening cattle. In the preparation called *Hominy*, the grain is soaked, and then exposed to a dry heat, which causes the bran or outer coat of the grain to crack and peel off, when it is easily separated. *Pop-corn* is another American preparation of maize made by slightly baking the unripe grains. The corn cobs form a very cheap and useful fuel. The fine starchy powders of maize, as of rice, are chemically bleached and sold as corn flours.

GUINEA CORN, DURRA, OR TURKISH MILLET (*Sorghum vulgare*, Pers.).—"A roundish grain, in shape not unlike maize, but not of greater bulk than a small grain of wheat; its colour is a yellowish white. It is borne in loose tufts or panicles: the stalks are about eighteen inches to two feet in height, and when dry, are very rigid; in this state they are much used in the manufacture of carpet-brooms and whisks. The grain itself is used in this country for feeding poultry. It is suspected that wheaten flour is not unfre-

quently adulterated with it, but this can only occasionally take place, as the importation of *durra* is very irregular. It is much used as food for the black population in the West Indies, whence it has been called *negro* corn; they make of it cakes about an inch thick, which are white, and tolerably palatable. It is also used by the poorer peasants of Italy. We receive it chiefly from Northern Africa; it is, however, cultivated in the United States, West and East Indies, and in Southern Europe. India is its native country." *

BUCKWHEAT.—Buckwheat wandered westwards, from its native home in Siberia and Turkestan, to the northern regions of Europe; whence, rather earlier than maize, it crossed the Atlantic to penetrate the regions of the south. Buckwheat is not a cereal grass but an exogen. Its grain, resembling the beechnut, whence its name (*bock*, beech), contains farina which makes a national dish in Russia, and is an important food substance in North Germany, the Netherlands, and in those parts of the Alps where the latitude forbids the ripening of maize. Buckwheat presents a pretty appearance in the field, with white flowers and ruddy stems, and has become indispensable where other grain does not flourish, but disappears before wheat, maize, rice, and millet.

## C.—*The Leguminosæ* (*Pulse Family*).

This great family of plants contains numerous species with nutritious seeds, which, under the general term *pulse*, form important articles of commerce. Legumes comprise, in temperate climates, the Common Pea (*Pisum sativum*, L.), the Horse Bean (*Faba vulgaris*, Moench), the Hari-

* Archer's "Economic Botany," p. 8.

cot or French Bean (*Phaseolus vulgaris*, Sari), the Lentil (*Ervum lens*, L.); and, in the tropics, the Ground Nut (*Arachis hypogæa*, L.), the Chick Pea (*Cicer arietinum*, L.), and the Carob Bean, or St. John's Bread (*Ceratonia siliqua*, L.).

Peas, beans, and lentils are grown in Poland, Prussia, Pomerania, Denmark, East Friesland, and other countries. They create considerable business in the large sea-port towns on the Baltic and German seas, whole cargoes being brought to those places as provisions for ships. Vetches or tares are largely cultivated as green fodder for cattle, while the dried peas serve as the chief food of the domesticated pigeon. The tropical species of pulse are not so well known, and require description.

GROUND NUT (*Arachis hypogæa*, L.). This plant is cultivated in America, in the Southern States, and forms an article of food in many parts of Africa. It is a low creeping plant, indigenous to the western coast of Africa, with yellow flowers, having the general appearance of a dwarf garden pea, although more bushy. After the flowers drop off and the pods begin to form, the stalk or support of the pod elongates, *thrusting the pod under ground*, where it comes to maturity. The seeds contain a considerable quantity of oil. They are roasted in the pods, and are sold in the United States in large quantities, being a favourite dainty with children. This plant is very prolific, and, in warm climates, requires but little care and attention in its culture. In the green state it is greedily devoured by cattle. There is a large trade in ground nuts from Africa to Marseilles and England for their oil.

CAROB BEAN, OR ST. JOHN'S BREAD (*Ceratonia siliqua*, L.).—The carob tree is peculiarly Oriental, and abundant in Palestine. It has large pods, the seeds of which are enveloped in a sweet nutritious pulp, supposed to be the

locust bean on which St. John the Baptist fed when in the wilderness. This tree is common in the Levant and the south of Europe, where its beans are used as food. Most of the carob beans imported into this country come from Sicily and Naples. During the Peninsular war the horses of the British cavalry were fed on these beans. The edible carob is a product of human labour and skill, since, like the olive and date-palm, it must be grafted before bearing nutritious beans. Even then the fruit is unwholesome or poisonous until ripe.

CHICK PEA (*Cicer arietinum*, L.).—This plant is a native of Southern Europe and the East. Its seeds are parched, and in Spain are sold in the shops for food. They are also abundant in the bazaars at Calcutta, and sold as food for horses. Every part of this plant exudes oxalic acid, and it is used by the Ryots of India in their curries instead of vinegar. When roasted, it is said to sustain life longer than other food in similarly small quantities; hence it is used by travellers through the deserts, where the carriage of bulky food is inconvenient.

## II.—THE STARCHES OF COMMERCE, AND THE PLANTS WHICH PRODUCE THEM.

Starch is an abundant product of the vegetable kingdom, and is in demand for domestic and manufacturing purposes. It exists in mealy farinaceous seeds, fruits, and roots, differing in its appearance according to the plants from which it is obtained. Starch is the nutritive matter of plants, and is changed by light to *chlorophyl*, and by *diastase* into gum and sugar, which are carried into the circulation for the support of the new growths of plants. Starch is turned blue by iodine.

THE ARROWROOT PLANT (*Maranta arundinacea*, L.; natural order, *Marantaceæ*) is a native of tropical America and the West Indies. In arrowroot, tapioca, and sago, starch exists in a state of almost absolute purity. The arrowroot

plant has large, herbaceous, and very handsomely-striped leaves, and tuberous roots, which abound in fecula or starch. These roots are grated, thrown into a vessel of water, and well stirred, when the fibrous portion comes to the surface and is rejected, the starch settling at the bottom of the vessel. This, after repeated washings, is dried in the sun, and constitutes the arrowroot of commerce, employed as a nutritive diet for invalids and children.

*Zamia integrifolia*, Wild (*Coontie*); natural order, *Cycadeæ.* An arrowroot is now manufactured at Key West, in South Florida, from the stem of this plant, which is short and globular, and abounds in starch. This cycad, which was called by the Indians *coontie*, grows over an immense area of otherwise barren land. These manufactures bid fair to become as extensive and profitable as those of Bermuda, whence at present our chief supplies of arrowroot are received.

*Tous-les-mois*, the starch of the rhizome of a species of canna (*C. edulis*); natural order, *Marantaceæ.*—This starch resembles a fine quality of arrowroot; but the granules are much larger than those of any known starch. Tous-les-mois comes from the island of St. Kitts, and is only used as food.

TAPIOCA PLANT (*Manihot utilissima*, Plum.; natural order, *Euphorbiaceæ*).—Tapioca is another form of starch, obtained by grating and washing the roots of the plant, which, under the name of mandioc or cassava, forms a most important article of food in South America. Washing removes a narcotic poisonous principle which exists in the sap. The Indians dissipate it by heat, simply roasting the root. The starch softened by heat, and afterwards granulated, constitutes tapioca. The ungranulated starch is the Brazilian arrowroot of commerce. The tapioca plant, in its native clime, is a shrub about five feet high, with roots which, when ripe, are about as large as a Swedish turnip and weighing sometimes as much as thirty pounds.

The common starch of the shops, used in domestic economy, is obtained from wheat, rice, and potatoes, and is almost if not entirely home-manufactured.

SAGO PALMS (*Saguerus Rumphii*, Wild.; and *Sagus lævis*, Gærtn.).—Sago is obtained from several species of palm. The sago of commerce is chiefly produced by these two plants. It is obtained from the cellular tissue or pith in the interior of the trunk.

The sago palm produces, like rice, a chief means of nourishment for millions in warm climates, since sago powder is generally used for making bread. It grows in the south of China, Japan, and all over the East Indies, but principally in the islands of the Indian archipelago. It flourishes best in swampy ground, a good plantation being often in a marsh. Its trunk is from five to six feet in circumference, rising to a height of about twenty feet. Sago is not obtained until the tree is fourteen or fifteen years old. A single tree is said to yield from five to six hundred pounds.

Most of the sago imported into the United Kingdom comes to us from the island of Singapore, where it is manufactured as follows:—The pith, which is soft, white, spongy, and mealy, is first removed from the interior of the stem, then bruised and put into large tubs of cold water; the woody particles of course float, and are easily removed, and the weightier starch or sago powder settles at the bottom of the vessel. The water is then poured off, and the dried sago powder passed through small sieves made of the fibres of the palm leaves. In passing through these sieves, the sago powder acquires its granulated character. The preparation is then finished, and the sago is ready to be put into boxes, or placed in bags for shipment.

Sago is insoluble in cold water, but by boiling becomes soft, and at last forms a gelatinous solution. In England it is much used for puddings; and as it is both nutritive

and easy of digestion, it constitutes an excellent article of diet for the invalid and the convalescent.

A great deal of German or potato sago comes into the European market, and is with difficulty distinguishable from the real East Indian sago.

Technical knowledge is needed in judging of the edible starches, which enter into commerce under such names as corn-flours, arrowroots, and sagos. Pure arrowroots, obtained from the *Maranta*, such as those of Bermuda and St. Vincent, are known by their large granules and crisp feel between the fingers. Potato farina, sold largely as cheap arrowroot, consists of a fine powder-like flour, with little or no granulation; though sometimes artificially granulated to imitate the true sago of the East. From its hygroscopic properties, potato arrowroot, which contains naturally 18 per cent. of water, absorbs double that quantity when the atmosphere happens to be damp.

## III.—Plants yielding Spices and Condiments.

Cinnamon (*Cinnamomum Zeylanicum*, Nees.; natural order. *Lauraceæ*).—This plant is an evergreen aromatic tree, about thirty feet in height, and indigenous to the island of Ceylon. Its leaves are oval, smooth, entire, with three prominent curvilinear ribs on the under surface. The young leaves are at first red, but change gradually to a yellowish green, possessing the same flavour as the bark, but in a less degree; flowers panicled, white with a brownish centre, devoid of fragrance, and about the same size as those of the lilac.

The inner bark of this tree constitutes the cinnamon of commerce, and the young twigs furnish the best. After the trees are nine years of age, the twigs are cut annually in the month of May, by the cinnamon peelers, or Choliahs, as

they are called in Ceylon. This is done with a sharp iron instrument. The bark is removed by making a longitudinal and then a transverse incision into the shoot, inserting under the bark the point of the peeling-knife, and raising the handle of the knife as a lever. The next day the inner fibrous bark, in which resides the delightful flavour of cinnamon, is easily removed from the outer bark, and this, as it dries, curls up and forms quills. Before these quills become dry, hard, and brittle, the smaller are inserted into the larger; space in packing is thus saved, and compact sticks are formed, which are not so liable to breakage as the single quills.

Since neither the leaves nor the flowers of the cinnamon tree give forth any smell, it is only when the season arrives for gathering bark that the visitor to the gardens will enjoy the perfume of this plant. A walk through the cinnamon gardens during the busy season is truly charming. The grove is then full of fragrance, and a scene of cheerful industry. Everywhere are to be seen groups of Cingalese peeling the twigs, which they do with astonishing quickness, making a great deal of money whilst the season lasts. The Choliahs form a distinct caste, and are considered very low, socially, so that, according to Cingalese notions, it is personally degrading for any one else to follow the business. The largest of the cinnamon gardens in Ceylon is that near Colombo, which covers upwards of 17,000 acres of land.

Cinnamon trees are preserved with the greatest care by their proprietors. By the old Dutch law the penalty for cutting or injuring them was amputation of the hand; at present a fine is imposed upon the delinquent.

Somewhere near a million pounds of cinnamon are imported into this country, a great part of which we re-export to our colonies. Considering the extreme lightness

of cinnamon bark, this is a large quantity. Cinnamon is usually brought home in bags or bales of eighty to ninety pounds weight. The best comes from Ceylon, but the cinnamon tree grows plentifully in Java, Sumatra, Malabar, and Cochin-China, and it has been recently transplanted to the Mauritius, the Brazils, and Guiana, and to the West India islands of Tobago, Guadaloupe, Martinique, and Jamaica. The cinnamon produced in the West is, however, not so good as the Oriental.

Cinnamon is an aromatic tonic of an agreeable odour and taste, which acts as a grateful stimulant or carminative, creating warmth of stomach, removing nausea, expelling flatulency, and relieving colic or intestinal pain. It owes these properties to the volatile oil which it contains. Cinnamon is much employed as a condiment in culinary preparations, and is also frequently used for flavouring and disguising unpleasant medicines, or as an adjuvant—that is to say, an assistant.

*Cinnamomum Cassia* seems to be the chief source of the *Cassia lignea*, or bastard cinnamon of commerce. This plant differs from the true cinnamon tree in many particulars. Its leaves have the taste of cinnamon, to which also its bark bears a great resemblance, but is thicker, rougher, denser, and not so agreeable in flavour. It is cultivated in China, and is imported from Canton, *viâ* Singapore, in chests similar to those in which the tea is packed. Our imports of Cassia are hardly more than a third of our imports of cinnamon.

NUTMEG TREE (*Myristica moschata*, Thunberg).—This tree, from twenty to twenty-five feet in height, strongly resembles our pear-tree in its general appearance, and also in its fruit, which is not unlike the round Burgundy pear. The leaves are aromatic when bruised; the flowers, pale, bell-shaped, without a calyx. The fruit is a fleshy pericarp,

opening by two valves when ripe, and displaying the beautiful scarlet, reticulated arillus, or mace, enveloping the thin, dark-brown, glossy, oval shell, which covers the kernel, the nutmeg of the shops. Each fruit contains a single seed, or nutmeg. The mace and the nutmeg are both valuable spices. The former, although a brilliant scarlet colour when fresh, becomes yellow, brown, and brittle when dry. Nutmeg trees bear fruit the seventh year, and increase in produce till the fifteenth, when they yield an average of five pounds of nutmegs and one and a half pounds of mace. They bear all the year round, and are said to continue prolific for seventy or eighty years.

Whilst the clove has spread over Asia, Africa, and the West Indies, the nutmeg tree refuses to flourish, except in the islands of the Malayan Archipelago. In 1819, 100,000 of these trees were transplanted by the British Government to Ceylon and Bengal, but the plantations were not successful. Attempts to introduce the nutmeg tree into other tropical countries have failed until quite recently, when shipments of seedling plants to Brazil and the West Coast of Africa have given promise of successful culture.

The Dutch endeavoured to extirpate the nutmeg from all the islands of the Moluccas except Banda, and they had all the trees removed thither for better inspection; but this attempted monopoly was completely frustrated by the mace-feeding wood pigeons. These birds conveyed and dropped the fruit beyond the assigned limits, spreading it over the whole of the islands of the Malayan Archipelago, from the Moluccas to New Guinea.

Of the nutmegs and mace received, a large part, as with the other spices, is re-exported, England having taken the place of Holland as the world's emporium for this division of commerce.

The nutmeg and clove trees were first introduced into

this country by Sir Joseph Banks as ornamental hot-house plants, about 1797.

Nutmegs and mace are employed chiefly as condiments for culinary purposes, for which they are admirably suited by their agreeable taste and stimulating properties. As remedial agents they owe their activity to the volatile oil which they contain, and when administered in moderate quantities, produce the usual effect of the other spices.

THE CLOVE TREE (*Caryophyllus aromaticus*, L.; natural order, *Myrtaceæ*, the Myrtle family).—Cloves are the unexpanded flower-buds of this tree, which is an evergreen, the trunk rising from fifteen to twenty feet above the ground. The flowers are produced in great profusion, in short terminal panicles of from nine to eighteen in each bunch. The corolla is red, and, before expansion, forms a ball or sphere at the top of the calyx. The pedicles, or flower-stalks, are divided into threes, and articulated or jointed. This greatly facilitates the fall of the buds when the gatherers beat the trees with reeds or wands. They are also gathered by hand—a method adopted when the season has been unfavourable.

The clove tree is a native of the Moluccas, where it was very abundant before the conquest of these islands by the Dutch. They extirpated it from all the Moluccas except Amboyna, and even there they allowed only a limited number of trees to be planted, lest the *price should fall too low!* This narrow policy stimulated other nations to try to get so valuable a spice. In 1770 the French obtained the plant, and introduced it into the Isle of Bourbon, and from thence to Cayenne and to their other possessions in America. But the best cloves still come from the Moluccas, those from other places being smaller and containing less oil.

We receive cloves from the East and West Indies, from the Mauritius, and indirectly from Holland. Small and

light as are these fragrant flower-buds, we count our imports by hundreds of tons.

Dr. Ruschenberger, who visited Zanzibar, on the eastern coast of Africa, in 1835, thus speaks of the clove plantations there:—"As far as the eye could reach over a beautifully undulating land, nothing was to be seen but clove trees of different ages, varying in height from five to twenty feet. The form of the tree is conical; the branches grow at nearly right angles with the trunk, and they begin to shoot a few inches above the ground. The plantation contains nearly 4000 trees, and each tree yields, on an average, six pounds of cloves annually. They are carefully picked by hand, and then dried in the shade. We saw numbers of slaves standing on ladders gathering the spice, while others were at work clearing the ground of dead leaves. The whole is in the finest order, presenting a picture of industry and of admirable neatness and beauty."

Cloves, when good, are dark, heavy, and strongly fragrant, the ball on the top being unbroken, and yielding oil when pressed with the nail. This oil is sometimes extracted, and the cloves so treated are mixed with the others. They are also sometimes adulterated with water, which they absorb readily, becoming plumper and heavier.

Cloves are much employed in cookery as a condiment, being the most stimulating of the spices. The oil of cloves is a popular remedy for the toothache, and the infusion a warm and grateful stomachic. Cloves are frequently employed by medical men to disguise the nauseous properties of their drugs, and thus render them more palatable to the patient.

ALLSPICE, PIMENTO, or JAMAICA PEPPER (*Eugenia Pimento*, D. C.; natural order, *Myrtaceæ*).—This plant is called *allspice* because it has the combined flavour of all the other spices—that of cinnamon, cloves, and nutmegs entering

into its composition. The unripe berries of this plant, dried in the sun, form the allspice. The plant itself is a handsome evergreen, with a straight trunk about thirty feet high, covered with a smooth grey bark. Its leaves abound in an essential oil, to which the pimento owes its aromatic properties. The flowers are greenish white, and the fruit is a smooth, shining, succulent berry, black when ripe, and containing two uniform seeds, the flavour of which resides within the shell.

The allspice is a native of the West Indies, where it is cultivated—particularly in Jamaica, in the hilly parts of the country—in plantations, having broad walks between the trees, called "pimento walks." It begins to bear fruit when three years of age, and arrives at maturity in seven years. Nothing can be more fragrant than the odour of the pimento trees, especially when in bloom; even the leaf emits a fine aromatic odour when bruised.

The berries are collected before they are ripe, at which time the essential oil, to which they owe their flavour and pungency, is most abundant. They are spread out, exposed to the sun, and often turned. In about a week they have lost their green colour, and have acquired that reddish-brown tint which renders them marketable; they are then packed in bags and casks for exportation. When dried, these berries are rather larger than a peppercorn. Some plantations kiln-dry them, which expedites the process very considerably.

The consumption of allspice in this country is great, as it is both cheap and useful. The berries reach the ports of Liverpool and London in bags of about a hundredweight, four-fifths of the quantity being retained for home consumption. Its oil, like that of cloves, is employed as a remedy for toothache.

PEPPER (*Piper nigrum*, L.; natural order, *Piperaceæ*).—

This is a climbing vine, with dark green leaves, and small flowers, in long, slender, drooping spikes, which are opposite. Its fruit is a round, sessile, one-sided berry, first green, then red, and finally black.

The pepper vine is indigenous in the East Indies, and is extensively cultivated in Sumatra, Java, and on the Malabar coast. A little pepper is also grown in the Mauritius and in the West India Islands.

The berries, which resemble those of our holly in size and colour, are gathered as soon as they begin to redden; for if allowed to ripen fully, they lose their pungency. They are dried in the sun. In drying they become wrinkled and black, in consequence of the drying of the pulp over the greyish white seed. In this state they are known as black pepper, which is the most powerful variety.

White and black pepper are produced by the same plant; the difference in colour is only the result of a difference in the preparation of the berries. To obtain white pepper the berries are allowed to ripen, then dried and soaked in water, and the softened black outer coat is removed by rubbing. The internal seed is of a whitish grey colour, and, when dried, forms white pepper.

Pepper is a warm carminative stimulant, which is added to food principally for the object of correcting the flatulent and griping character of certain articles of diet—peas and beans, for instance. Both varieties of black and white pepper are sometimes used whole, in soups and pickles, but they are mostly ground in a mill, and sold in the form of a powder.

The quantity of pepper annually imported into the United Kingdom is immense, but varies considerably from time to time. From 5000 to 10,000 tons of the dried unripe black berries and white ripened seeds of the pepper plant reach this country from the East Indies, chiefly from

Sumatra and Java; also from Malacca, Siam, and Singapore.

The pepper vine is strictly tropical, but it will grow freely from cuttings wherever the soil and climate are suitable. It is allowed to climb props from ten to thirteen feet in height; these props root freely, the tree from which they are cut being selected with that object in view. The props thus afford both shade and support to the plants. Great care is necessary in the management of the vine, especially in training and tying it to the props. An acre of pepper vines affords an average annual yield of 1160 lbs. of clean pepper.

LONG PEPPER (*Piper longum*, L.; natural order *Piperaceæ*). This species is wholly different from the black pepper, and is found wild in India, and cultivated in Bengal. The long pepper consists of the fruit catkins of the plant dried in the sun. Long pepper is expensive, but is, nevertheless, of considerable economic importance either as a condiment or a medicine.

CAYENNE PEPPER (*Capsicum annuum*, L.; natural order, *Solanaceæ*).—Cayenne or red pepper is not the produce of a pepper plant, but is prepared from the large, red, inflated, pod-like berries of the capsicum, dried and reduced to powder. The capsicum is a native of the East and West Indies, but cultivated in England, where it can be grown with a very little care. There are numerous species of capsicum, named after the form and colour of the pod, which varies considerably. All are, however, included under the Mexican name of Chillies. In tropical countries chillies are used in great quantities, the consumption being almost universal and nearly equal to that of salt. In India they are the principal ingredients in all curries, and form the only seasoning which the millions of the poor of that country can obtain to eat with their insipid rice. The

natives of the tropics can eat and relish them raw, which cannot be done by strangers from temperate climates without suffering, the pungent and acrid action of the chillies affecting the mouth and throat. Some, however, are much milder than others, and all are so if eaten while green. The pungency, residing chiefly in the seeds, increases with drying. The Sweet Capsicum of Spain, *Pimento dulce*, when fresh, is a very pleasant addition to a dish, but the seeds are not used.

Capsicums or chillies are imported into this country in the form of red and brown pods, which are broken, dried, and packed in bales, weighing 2½ cwt., principally for making red pepper. Different varieties are cultivated for pickles, and are imported in the pickled state in vinegar from the East Indies. The annual imports from the East and West Indies approach a hundred tons. Capsicums are useful in cases of putrid sore throat, in malignant scarlet fever, as a powerful irritant to be applied in the condition of a saturated infusion externally, so as to draw the internal inflammation to the surface, and thus relieve the throat.

GINGER (*Zingiber officinale*, Roscoe; natural order, *Zingiberaceæ*).—This is an elegant reed-like, tropical plant, which rises from a creeping *rhizome* or underground stem. The aërial stem is formed by the cohering bases of the leaves. The flower stem springs from the rhizome. The dark purple flowers are arranged in spikes.

The ginger-plant is a native of the East and West Indies, and is now cultivated generally in hot climates. The ginger of commerce is the dry, wrinkled rhizomes of the plant, which are called "races," and are usually from two to three inches in length, branched, flat, and white in colour. Sometimes the root is dug up when a year old, scalded to prevent germination, and then dried. So prepared, it is called "black ginger," although this term is very erroneous, as the

darkest ginger is only a dirty stone colour. Again, the best pieces are selected, the outer skin is scraped off before the ginger is dried, and the pieces, bleached with chloride of lime, constitute what is known in the market as "white ginger." This bleaching process renders the ginger beautifully smooth, but certainly does not improve its quality. Lastly, the *races*, newly formed in spring, are cut off, and boiled in syrup; and the ginger, so treated, is imported in jars under the name of "preserved ginger," forming a well-known sweetmeat.

The varieties of ginger recognised in commerce are the Jamaica white ginger, and the Jamaica and Malabar black gingers; also the black varieties, or the Barbadoes, African, and East Indian gingers. Jamaica ginger is considered to be the best. The amount of ginger annually imported into the United Kingdom is very considerable. The principal use of this spice is as a condiment. Medicinally it is an excellent stomachic, removing flatulence and griping pains. In the form of a poultice, it forms a good counter-irritant.

CARDAMOMS (*Elettaria cardamomum*, Maton; natural order, *Zingiberaceæ*).—Cardamom seeds are obtained from several other allied plants, but those of the above species of *Elettaria* constitute the true officinal Malabar cardamoms.

The cardamom is an obtusely triangular three-celled pod, about half an inch in length, of a pale straw colour, and furrowed longitudinally on its outer surface. This pod contains numerous reddish-brown seeds, about the size of mustard seeds, internally white, and having a pleasant aromatic odour and an agreeable taste.

Cardamoms are principally employed here in medicine as a flavouring ingredient, and occasionally as a stimulant and carminative, especially in the form of a simple or compound tincture. In India they are much used as a favourite condiment for various kinds of food, as curries,

ketchups, and soups. Their active principle is a pungent volatile oil.

Cardamoms are shipped to this country from Ceylon, the Malay peninsula, Sumatra, Java, Siam, Cochin-China, and the Malabar coast. The quantity of all kinds imported is of minor commercial importance.

VANILLA (*Vanilla aromatica*, Sw.; natural order, *Orchidaceæ*).—The vanilla is an epiphyte or air-plant with a trailing stem, not unlike the common ivy, which attaches itself to trees not as a source of food, like the mistletoe and other parasites, but as a mere point of support, deriving its nourishment entirely from the atmosphere. It grows from eighteen to twenty feet in length. The flowers are greenish yellow mixed with white, and these are followed by a long slender pod, the fragrance of which is owing to the presence of benzoic acid, crystals of which form upon the pod if left undisturbed. This is, perhaps, the most important genus of the whole orchideous family, and the only one which possesses any marked economic value. It grows in the tropical parts of South America, in the Brazils, Peru, on the banks of the Orinoco, and in all places where heat, moisture, and shade prevail.

The pods or fruit of the vanilla are about eight inches long, one-celled, and pulpy within, filled throughout with very minute black oily seeds, having the appearance of a black paste.

To prepare vanilla for market—"When about 12,000 of the pods are collected, they are strung like a garland by their lower ends, as near as possible to their foot-stalks; the whole are plunged for an instant into boiling water to blanch them, they are then hung up in the open air, and exposed to the sun for a few hours. Next day they are lightly smeared with oil, by means of a feather or the fingers, and surrounded with oiled cotton to prevent the valves from opening. As

they become dry on inverting their upper end, they discharge a viscid liquor and are pressed several times with oiled fingers to promote its flow. The dry pods lose their appearance, grow brown, wrinkled, and soft, and shrink into one-fourth of their original size. In this state they are touched a second time with oil, but only very sparingly, because if oiled too much, they would lose a great deal of their delicious perfume. They are then packed for the market in small bundles of 50 to 100 in each, enclosed in lead foil or light metallic cases." *

As an aromatic, vanilla is much used by confectioners for flavouring ices and custards. The Spaniards employ it extensively in perfuming their chocolate. It is difficult to reduce it to small particles, but it may be sufficiently attenuated by cutting it into little bits, and grinding these along with sugar. The quantity imported into this country is comparatively small.

The use of vanilla and many other natural aromatic essences has been greatly interfered with by the beautiful discoveries in the chemistry of ethers, which render it now easy to prepare artificially, not an imitation of flavouring substances, but the very same essences as are yielded by the choicest fruits and flowers.

### *Umbelliferous Plants with Aromatic Fruits.*

The fruits of the caraway, coriander, and anise—called in commerce seeds—although cultivated in this country, are imported somewhat largely from the Continent.

CARAWAY (*Carum carui*, L.).—The caraway is indigenous to most parts of Europe. It is cultivated to some extent in Essex and Kent. The taste of the seeds is aromatic

* See Ure's "Dictionary of Arts and Manufactures," Vol. 3, p. 974. 1867.

and warm, and their odour is fragrant, but peculiar. The seeds are much used by the confectioner, and are sometimes added to bread; coated with sugar, they form the well-known "caraway comfits" to which children are so partial. We import several hundred tons of caraway seeds annually from Germany and Holland, nearly the whole of which are retained for home consumption.

CORIANDER (*Coriandrum sativum*, L.).—The fruit of this plant is globose, having a peculiar smell, and a pleasant, aromatic taste. In a fresh state both the fruit and foliage have an extremely disagreeable odour; nevertheless, the Tartars are said to use it in the preparation of a favourite soup.

The coriander is indigenous to Southern Europe and Italy, but has a wide geographical range, bearing the climate of India and Britain equally well. It is cultivated in this country, particularly in Suffolk and Essex, and is valued both by the apothecary and the distiller. Coriander is used in medicine for its carminative and aromatic properties, as a corrective to the griping qualities of cathartics. It is more used in confectionery than in medicine. Coriander seed is also employed in adulterating beer. The poor Indian mixes these seeds with his curry, and they are equally welcome at the tables of the rich.

ANISE (*Pimpinella anisum*, L.).—This is a perennial plant, with an erect, round, striated, rough, or downy stem; white flowers, and an ovate, downy, aromatic fruit, resembling the finer kinds of parsley seed in shape, and sweetish to the taste.

The oil of anise is obtained by distillation from the seed, about one cwt. of seed yielding two pounds of the oil. It is used in confectionery and in medicine. Anise is indigenous to Egypt, but is grown in Malta, Spain, Italy, France, Germany, and the East Indies. The principal imports are from Alicante in Spain, and Hamburg in Germany.

Other umbelliferous plants used as condiments are cumin and angelica.

STAR ANISE (*Illicium anisatum;* natural order *Magnoliaceæ*).—This plant is so called because the flavour of aniseed pervades the whole of it, especially the fruit; but it is not at all allied to anise, belonging to a totally different natural order. It is a shrub indigenous to China and Japan; its fruit is used to flavour sweetmeats, confectionery, and liquors. The aromatic oil of star anise, singularly enough, in every respect resembles anise oil, for which it is often substituted. In India, star anise is an important article of commerce, and sold in all the bazaars.

MUSTARD.—The seeds of *Sinapis nigra*, L., often mixed with *S. alba* (natural order, *Cruciferæ*).—The spherical seeds of these two species are crushed, pounded, and then sifted through a fine sieve; the fine, powdery product is the "flour of mustard" in common use. The outer skin of the seeds, separated by sifting, forms a coarse powder, which is sold for adulterating pepper. Mustard seed is largely imported from the East Indies for the oil; and white mustard seed is imported from Northern Germany, for grinding with the black mustard seed grown in this country.

## IV. PLANTS YIELDING SUGAR.

SUGAR-CANE (*Saccharum officinarum*, L.; natural order, *Gramineæ*).—This plant, next to rice and maize, is the most valuable of the tropical grasses. Its stem is solid, cylindrical, and jointed, two inches in diameter, and from twelve to fifteen feet in height; its leaves are long, narrow, and drooping; flowers handsome, appearing like a plume of white feathers, tinged with lilac. A field of sugar canes in blossom presents a beautiful appearance.

The sugar-cane is seldom permitted to flower under

cultivation. It is propagated by sections of the culm, or stem, with buds in them. Trenches are cut, and the pieces of the culm are laid horizontally therein; the earth is then thrown into the trench, and the canes soon develop from the nodes or joints of the culm. As the wind gains power over them, the lower leaves are removed, and the stems are strengthened by being fastened to bamboo supports.

The sugar-cane plant is sensitive to cold, and therefore its cultivation is restricted to the tropics and regions on their borders where there is little or no frost. In the Old World sugar plantations are confined to countries lying between the 40th parallel of north latitude, and a corresponding degree south; in America, along the Atlantic seaboard, they do not thrive beyond 33° north latitude, and 35° south latitude; whilst on the Pacific side, the sugar-cane matures about 5° further to the north and south of the equator. The principal countries where sugar is largely grown are the West Indies, Venezuela, Brazil, Mauritius, British India, China, Japan, the Sunda, Philippine, and Sandwich Islands, and the Southern United States of America. Moreton Bay and the northern parts of Australia are admirably suited, both in soil and climate, to sugar culture.

*Manufacture of Sugar.*—When the cane is ripe, it is cut down, deprived of its top and leaves, cut up into convenient lengths, tied up in bundles, and taken to the mill. Here the canes are crushed between iron rollers, the juice from them flowing into vessels, where it is boiled with the addition of lime, and evaporated to the consistence of syrup, care being taken to remove any scum which appears on the surface during this part of the process. The lime is added to remove any acidity and prevent fermentation. The material of the fire consists of the refuse crushed cane, dried for that purpose in the sun. Six or eight pounds of

cane-juice will yield one pound of raw sugar; and from sixteen to twenty cart-loads of cane ought to make a hogshead of sugar, when thoroughly ripe. The cane syrup thus prepared is transferred to shallow vessels, or coolers, in which it is stirred until it becomes granulated; it is then put into hogsheads having holes in the bottom, which are placed in an upright position over a large cistern, and allowed to drain. In this state it is called muscovado or brown sugar, and the drainings, molasses. The casks are then headed down and shipped. This muscovado is purchased by the grocers, and constitutes the brown or moist sugar of the shops.

The planters in the West Indies generally send their sugar to England in the form of muscovado; but in the French, Spanish, and Portuguese settlements, it is usually converted into clayed sugar before exportation. The process is as follows:—The sugar from the coolers is placed in conical pots with holes at the bottom, having their points downward. A quantity of clay is laid on the top and kept moistened with water, which oozing gently from the clay through the sugar, dilutes the molasses, and causes more of it to come away than in the hogshead, leaving it whiter and purer than the muscovado sugar.

Loaf, or refined sugar, is made from the muscovado by the sugar bakers in England. The muscovado is re-boiled, and refined with the serum of bullock's blood or the white of eggs; it is then transferred to conical moulds, and clayed repeatedly until perfectly white. The sugar is then removed from the moulds and set in a stove to dry.

The sugar-cane, a plant originally confined to Asia, and which grew wild in India, was introduced into the south of Europe from the East by the Saracens soon after their conquests in the ninth century. In the twelfth century, sugar plantations were established in Cyprus, Rhodes, Candia,

Malta, Sicily, and Spain; and as early as the beginning of the fifteenth century they had been extended to Granada, Murcia, Portugal, Madeira, and the Canary Islands.

The sugar-cane is now cultivated at only a few places in Europe, viz., Malta, Sicily, and the south of Spain. The rest of the sugar plantations have disappeared from the countries about the Mediterranean, in consequence of the extent of the great American plantations, and those in the West Indies.

In the middle of the sixteenth century the sugar-cane was transplanted by the Portuguese to Brazil, and by the Spaniards to the West Indies, where the greatest quantity of sugar is now produced. The South American fields of tufted cane have been displaced by more profitable coffee plantations; and sugar produce is more nearly confined to the West Indies. This is an industrial advantage to the planters of both regions, being in accord with the conditions under which the plantations flourish.

California makes promise of such profusion of sugar extracted from honey that there seems a possibility of the bee resuming its rank as the sweetener of the cup of life.

The East Indies, Java, Sumatra, the Philippine Islands, Siam, Cochin-China, Bengal (but not Ceylon) produce sugar for exportation. Sugar has been made in China, indeed, from very remote antiquity, and large quantities also have been exported from India in all ages.

Granulated sugars are prepared from a weak solution containing much water of crystallisation. They have less sweetening power than the dry, finely ground loaf cane sugar, which is not only best in quality but cheapest in the end. White refined beet sugar dissolves more readily than cane sugar, and its fracture is more symmetrical.

Sugars entering into British commerce are classified as (1) Cane sugar; (2) Beet sugar; (3) Date sugar; (4) Glucose,

or Grape sugar; to which we must now add, (5) Candy, or Californian Honey extracts; and (6), Saccharine, the latest and crowning triumph of a brilliant series of discoveries, which solved the problem, theretofore playfully set by experts as an impossibility in organic chemistry—"Given the equivalents of carbon and water, the constituents of sugar, to produce this sweetening substance from its elements." Saccharine has become a commercial commodity, making way in England and being used in Germany to heighten the powers of glucose and beet sugars, and the range of its future influence on the sugar industries is not easy to forecast. Its sweetening properties are reckoned to be many times greater than those of the product of the cane, and though its cost of production is at first 100 per cent. more than that of cultivated sugars, the new saccharine is doubtlessly destined to follow the economic course of valuable discoveries, and be produced by cheapened processes to meet any ulterior demand.

Glucose is chiefly obtained from starch, and comes either fluid or in mass. It is used in brewing, a duty being charged according to the saccharine matter contained in the beer.

*Rum, or Spirit of Sugar.*—The best is distilled from the pure juice of sugar, the inferior kind is made from treacle, and from the residuum in the sugar refineries. Jamaica rum is the finest, about three millions of gallons being annually imported into England from the West Indies. Rum is also distilled for exportation in Bengal, Penang, Batavia, and Manilla. The native arrack of India has been nearly driven out of the market by this spirit.

Besides the sugar cane, many other plants yield sugar. The principal of these are:—

1. Beet-Root and Mangold-Wurtzel (two varieties of *Beta vulgaris*, Tournef; natural order, *Chenopodiaceæ*) are

cultivated extensively on the continent of Europe, especially in France, where sugar is obtained from the juice of these sap roots. In Great Britain beet-root is eaten as a salad, and mangold-wurtzel is largely grown as winter food for cattle.

2. SUGAR MAPLE (*Acer saccharinum*, Wang.; natural order, *Aceraceæ*).—From the juice which flows from incisions made in the stem of this, and probably other, species of maple, large quantities of a coarse uncrystallisable sugar are manufactured in North America.

3. DATE (*Phœnix dactylifera*, L.; natural order, *Palmaceæ*).—From this useful palm (see p. 206), and also from *P. sylvestris*, L., and *Saguerus Rumphii*, sugar is produced by boiling the juice, which flows from incisions made in the flower-heads. These sugars are mostly consumed in India; part, however, reaches our shores, to find its economic mission as a concomitant of black beers.

## V.—PLANTS USEFUL IN THE PREPARATION OF NUTRITIOUS AND STIMULATING BEVERAGES.

The TEA-PLANT (*Thea viridis*, L., and *Thea Bohea*, L.; natural order, *Camelliaceæ*).—These two species are probably only varieties of the same plant. Native region, China and Japan.

The tea-plant is an evergreen shrub which attains in a state of nature a height of from twenty-five to thirty feet, but under cultivation seldom exceeds five or six feet, owing to the removal of its foliage by the cultivator.

All the numerous varieties of tea known in commerce are referable to one or other of the two grand divisions of green and black tea. Both are produced by the same plant, the difference in their colour resulting from a difference in their mode of preparation; or sometimes, from the use of colouring matters.

The green teas comprise Twankay, so called after the name of a stream in Chehkiang, where this sort is produced; Hyson, or, in Chinese, *yu-tsien*, meaning "before the rains," in allusion to the time of gathering; Gunpowder, or *ma-chu*, "hemp-pearl," referring to the globular form into which the leaves are twisted; Imperial—the finest kind of green tea—so named because it is only used by the emperor and the mandarins—this tea consists of the smallest and most tender light-green leaves of the first gathering; it is not easily obtained in Europe in the pure state.

The black teas include Bohea, named with reference to the range of the Bu-i hills, where it is grown; Congou, or *koong-foo*, signifying labour or assiduity; Souchong, or *siau-chung*, meaning small or scarce sort; and Pekoe, or *pe-kow*, "white hairs," in allusion to the down on the epidermis of the young spring leaves. The two last are the finest and most expensive of the black teas.

The preparation of green tea may be described in general terms as follows:—The leaves are gathered from the shrub, and placed in bamboo baskets; they are then put into shallow iron pans, placed over charcoal fires, and stirred continually and briskly, the rising steam being fanned away; after this they are removed from the pans, and whilst still flaccid with the contained moisture, are placed before the twisters, on a table made of split bamboo, and therefore presenting ridges; the twisters roll them over with their hands until twisted. The leaves are then spread out and exposed to the action of the air, and afterwards returned to the drying-pans, exposed there to additional heat, and kept continually stirred until the drying is complete, when they are picked, sifted, sorted, and so prepared for packing. Black tea is prepared in the same manner, with this difference, that the fresh leaves, as soon as collected,

are thrown together into heaps, and allowed to lie until a slight degree of fermentation ensues, or a spontaneous heating, similar to that which takes place in a damp haystack. This partial fermentation of the tea-leaves darkens their colour. All the black teas are grown in Fokien, a hilly and populous district about 200 miles to the north-east of Canton. The green teas are raised in the district of Kianguan, about 750 miles from the same city.

Owing to certain peculiarities in Chinese legislation, landed property is much subdivided, so that the tea is generally cultivated in small gardens or plantations, the leaves being picked by the family of the cultivator. The first gathering takes place in early spring, in the month of April—pekoe and hyson are made from this crop. It is scarcely over before the air becomes charged with moisture, rain falls, and this, combined with the warmth of the atmosphere, soon causes the tea-shrubs to put forth, in the month of May, the leaves of the second crop. A third gathering is made about the middle of June, and a fourth in August. The leaves of the first gathering are the most valuable, and from these the finest imperial and hyson, with pekoe, and similar qualities of black teas, are prepared. The leaves of the last crop are large and old, and consequently make preparations very inferior in flavour and value.

During the harvest when the weather is dry, the Chinese may be seen in little family groups on every hillside engaged in gathering the tea-leaves. They strip off the leaves with astonishing rapidity, and throw them into small round baskets made for this purpose out of split bamboo or rattan. These baskets, when filled, are emptied into larger ones and immediately conveyed to market, where a class of Chinese make it a business to collect them in large quantities, and partly manufacture them, drying them under a shed.

A second class, known as the tea-merchants, purchase the tea in this half-prepared state, and complete the manufacture, employing in the operation women and children. The tea-merchants begin to arrive in Canton about the middle of October, and the busy season continues until the beginning of March, being briskest in November, December, and January. The tea is brought to Canton either by land-carriage or by inland navigation. The roads are too bad to admit of beasts of burden attached to wheeled vehicles, so that the land-carriage is usually effected by porters.

In China, tea is the common beverage of the people, being sold in the public-houses in every town, and along the public roads, like beer in England. It is quite common for travellers on foot to lay down their load, refresh themselves with a cup of warm tea, and then proceed on their journey. A Chinaman never drinks cold water, which he abhors and considers unholy; tea is his favourite drink from morning to night, not mixed with milk or sugar, but the essence of the herb itself, drawn out with pure water. The Chinese Empire could hardly exist were it deprived of the tea-plant, so habituated are the people to its use.

The Japanese usually make tea by pouring boiling water on the leaves, after having first reduced them to powder. Neither the Chinese nor the Japanese use milk or sugar with tea.

Tea is imported in chests lined with thin sheet-lead, and with a paper, which the Chinese manufacture from the liber or inner bark of the paper mulberry (*Broussonetia papyrifera*, L.), silky in texture, straw-coloured, and made without size. When the tea is put into the boxes, it is pressed down first with the hand, and then with the feet, after which the boxes are nailed down and stamped with the name of the district grower or manufacturer.

The Chinese colour with Prussian blue the teas which they ship for the foreign market. Only a little of this dye is employed, so that its use is not productive of evil results. The Chinese never dye the teas which they retain for their own use. The green teas of commerce are sometimes only black teas coloured with Prussian blue. A few leaves of the *Camellia* and of a species of *Rhamnus* or buckthorn indigenous to China are found occasionally amongst the tea-leaves. The leaves of such British plants as the beech, elm, willow, poplar, hawthorn, and sloe, are far more abundant, proving that the tea is adulterated after it has arrived in this country. The adulteration is easily detected by comparing the leaves from the teapot with the genuine tea-leaf. Tea is also adulterated with old exhausted tea-leaves, which are re-dried and used again.

The stimulating and refreshing principle that gives economic value to tea is *Theine*, which, if not actual food to repair waste of tissue seems to possess an analogous function in preventing waste. The same principle occurs in *Maté* or *Paraguay Tea*, and in *Guarana*.

The consumption of tea by the Chinese themselves is enormous. They drink four times as much as we do. With rich and poor of all that swarming population, tea—not such as our working classes here drink, but fresh and strong, and with no second watering—accompanies every meal. The population of China, according to an official census, is more than ten times the number of inhabitants of the United Kingdom. Vast as is our consumption of tea, the consumption in China must therefore be forty times as great. There is likewise a heavy exportation, in native vessels from China to all parts of the East where Chinese emigrants are settled. The cultivation of tea in Australia has proved so successful, that not only does the colony now export its own growth, but the imports from China are reduced to a minimum.

The caravan or Russian teas are the best and most expensive used in Europe. They are brought overland from China by Russian merchants, who go there annually in caravans *viâ* Kyachta. These caravan teas, purchased by the wealthier Russian families, are preferred to those shipped in Canton, which are said to deteriorate in some degree through the sea air, and from being stowed away in the narrow and close holds of the vessels.

Tea was first brought to Europe by the Dutch in 1610, and they had for a long time the monopoly of the trade. The British East India Company entering the field as a competitor, soon obtained a fair share of the business. The sole object of the Company was to provide tea for the English market. Of this they had the exclusive monopoly until 1834, when the British Government passed an Act which threw open the tea trade to all disposed to engage in this branch of commerce.

Formerly the tea received in Europe was cultivated exclusively by the Chinese, now the culture of the tea-shrub is successfully carried on in other countries.

The Dutch were the first to break the charm of the Chinese monopoly, by introducing and cultivating the tea-plant in the rich and fertile island of Java. Their first experiment was so successful that numerous tea-gardens were soon under cultivation on the mountain range which runs through the centre of the island, where the plant escapes the scorching heat of the torrid zone, and finds by height, rather than by latitude, a climate adapted to its nature. A considerable quantity of tea is now annually shipped from Java to Amsterdam.

In 1810 an attempt was made to cultivate the tea-shrub in the Brazils, near Rio de Janeiro, and a colony of Chinese were induced to settle there, and attend to the plantations. The experiment did not succeed; the shrubs became

diseased, and the Chinese formally abandoned them. Another effort made in the same country in 1817 was unsuccessful, owing to difficulties arising from climate, the high price of labour, and the natural indolence of the natives. The experiment, however, was tried once more, and this time successfully, and tea culture is now prosecuted with energy, and success. The Rio Janeiro market is entirely supplied with tea of domestic growth; and the public of Brazil are satisfied that no plant is more deserving of attention.

Tea is cultivated in British India. Some years ago it was discovered that the tea plant was indigenous to our Indian territory of Upper Assam. This plant, supposed to be a distinct species, has received the name of *Thea Assamica*. It is a more vigorous plant than the Chinese species, and has much larger leaves. It grows in the warm moist valleys of the Himalaya mountains, the temperature and other conditions there being similar to the circumstances under which the Chinese plant is raised. The Assam Tea Company was started, and several thousand acres were soon under cultivation in the district stretching from Kemaon to the *hill tracts* acquired from the Sikhs. The plants grown are chiefly those raised from Chinese seed, the remainder are the indigenous plants of the district. The seeds of the Chinese plant were obtained by Mr. Fortune in China in the summer of 1850, and by him planted in Wardian cases. They germinated during the voyage, and reached their final destination—the plantations of the Himalayas—in fine condition. About 14,000 plants were thus added to the Assam collection. Chinese tea curers have been induced to settle in Assam, and both black and green tea are now manufactured from the Chinese and Assam plants. The latter produces a very strong tea, which answers well to mix with the low sorts of China tea. Large importations of tea from Assam have already been received in this country.

Land suitable for the culture of tea exists amongst the Himalayas to an almost unlimited extent, and the quantity raised annually and exported must increase as the plantations are extended and multiplied.

Paraguay Tea, or Maté (*Ilex Paraguayensis;* natural order, *Aquifoliaceæ*).—A small shrub with oval, wedge-form, toothed, smooth leaves, somewhat like those of the orange. This plant, which is, in fact, a species of holly, occupies the same important position in the domestic economy of South America that the Chinese plant does in this country. The leaves are prepared by drying and roasting—not in the manner of the Chinese teas, in which each leaf is gathered separately; but small branches with the leaves attached to them are cut from the plant, placed on hurdles over a wood fire, roasted, and then beaten on a hard floor with sticks. The dried leaves and stems thus knocked off are collected, reduced to powder, and packed in hide sacks. Each of these sacks, when full, contains from 200 to 250 lbs. of the tea. The sacks are sewed up, and as the hide dries and tightens by exposure to the sun over its contents, at the end of a couple of days the tea forms a substance as hard as stone, and almost as heavy.

Paraguay tea is, therefore, in the form of a greenish-yellow powder, mixed with broken leaves and stems. This is infused in boiling water, and sucked up, by means of a tube perforated with small holes. It is usually imbibed out of a small gourd or cup with a little sugar, and sometimes an aromatic is added, such as orange or lemon-peel, or cinnamon. Maté is generally disagreeable to those unaccustomed to its use, but a taste for it is soon acquired, and it is very refreshing and restorative to the human frame after great fatigue. The best tea is made from the leaves of the youngest plants. Cheaper and more invigorating than tea or coffee, and not losing its flavour so quickly by

exposure, the wonder is that maté has not long since proved a powerful commercial rival to those commodities.

It has been calculated that 40,000,000 lbs. of Paraguay tea are annually consumed in the various South American republics. Mr. Miers gives eight sources of *maté*.

COCA. Allied to maté as a stimulating beverage, is an infusion of the leaves of the *coca* plant, long known to the Indians of Peru and Bolivia as a means of resisting hunger and fatigue. A fluid extract is prepared which is said to give elasticity to the action of the heart, to remove the depression of indigestion, to impart vigour to the muscles and intellect, and to excite an indescribable feeling of exhilaration to the whole system.

Coca has been found of marvellous effect as a specific for the cravings of the victims of opium and morphine, and also in chronic asthma, a few days' treatment effecting a cure. The yield of coca in South America is computed at thirty millions of pounds. Its use is widely spread, and is extending in Europe.

COFFEE TREE (*Coffea Arabica*, L.; natural order, *Rubiaceæ;* sub-order, *Cinchonaceæ*).—An evergreen shrub, from fifteen to twenty feet in height, with an erect stem covered with a brownish bark, and opposite branches with a slightly downward inclination, giving to the whole shrub an elegantly beautiful pyramidal contour or outline. Leaves, glossy dark-green above, paler beneath, and from two to three inches long; flowers, white and funnel-shaped; fruit, a globular two-celled and two-seeded berry, about the size of a cherry. The seeds, freed from their hard, horny parchment-like husk, are hemispherical, with one side convex, and the other flat and furrowed.

The flowers of the coffee-tree resemble those of the white jessamine, and appear in clusters in the axils of the leaves. The trees are very beautiful and fragrant when in

bloom, and not less attractive when the berries are ripe and ready for cropping, for these are then of a deep scarlet colour, and show to great advantage amongst the dark green glossy leaves.

The home of the coffee-tree is said to be Abyssinia, where it still grows wild; thence it was transplanted to Arabia towards the close of the fifteenth century. It was introduced by the Dutch into Batavia in 1690, thence carried to the West Indies and afterwards to the Brazils. Coffee is grown in almost every tropical country having an average temperature of above 55°. We receive it from Java in the East Indies, from Trinidad in the West Indies, from Rio Janeiro and Santos in South America. The best coffee comes from Mocha in Yemen, the southernmost province of Arabia.

As soon as the crimson colour of the coffee berry indicates the time for harvesting, the berries, which drop readily when mature, are shaken from the trees upon cloths or mats spread under them. They are next piled together in heaps for forty-eight hours to soften the pulp, and afterwards put into tanks through which water flows continually, to wash off the pulp; the berries are then spread out on the platform, with which every coffee estate is furnished, to dry in the sun. But there still exists the husk, which is broken off by means of heavy rollers; the seeds are then winnowed, and put into bags for sale.

Raw coffee is roasted, after it arrives in this country, in a hollow iron cylinder, which is kept turning for half an hour over a charcoal fire until the berries are coloured sufficiently brown. Roasting coffee brings out its reviving aroma and improves its flavour and power as a stimulant.

Coffee owes its properties to a peculiar principle, which has been called by chemists *Caffeine*, and which is identical both with the theine of the tea and the theobromine of the

cocoa plant. It is worthy of note that the common beverages of man—tea, coffee, and cocoa—although found in the most dissimilar plants, nevertheless contain precisely the same peculiar principle which gives them their nutritious and stimulating properties.

Coffee is said to have been first used by the Persians as early as 875 A.D., and from them the Arabs learned its value. The first chief who introduced it was Megalledin, Mufti of Aden, in Arabia Felix, who had become acquainted with the virtues of the berry when in Persia. The consumption was not rapid at the commencement, and, until 1554, none was publicly sold at Constantinople. It afterwards became popular with the Turks, but as it frequently led to social and festive meetings, which were considered incompatible with the strictness of Mahometan discipline, its use was restricted by the Turkish Government. The Turkish priests complained to the authorities that the mosques were deserted, whilst the coffee-houses were crowded; in vain the latter were shut up by order of the Mufti, and the police employed to prevent any one from entering, for the populace found means to elude their vigilance. The law became a dead letter, and although never repealed, the Government acknowledged its defeat by finally laying a tax on the beverage, thus making it a source of revenue.

The consumption of coffee in Turkey is very great; probably owing to the strict prohibition which the Moslem religion lays against wine and spirituous liquors. So necessary is it considered to be, that the refusal of it in reasonable quantities to a wife has been regarded a sufficient ground for a divorce. The coffee-houses in Turkey are very numerous and some of them spacious and handsome. In Constantinople, such as are regularly licensed are gaudily painted, and furnished with mats, platforms, and benches.

Sometimes there is a fountain in the middle of the room, which renders the atmosphere delightfully cool; and also a gallery for the musicians. Towards evening these houses become thronged with a motley assemblage of Armenians, Greeks, and Jews, all smoking and indulging in tiny cups generally drunk without either sugar or milk.

It is in the Turkish coffee-houses that the vagrant story-teller finds his stage and his audience. He walks to and fro, stopping when the sense of his story requires some emphatic expression or attitude, and generally contrives to break off in the most interesting part of his tale, making his escape from the room despite every precaution that may be taken to prevent him. His auditors, thus compelled to restrain their curiosity, are induced to return at another hour. Usually as soon as he has made his exit, the company present commence an animated discussion, in separate parties, as to the character of the drama, or the principal events of the narrative.

Coffee was first sold in London in 1652, by a Turkish merchant, who kept a house for that purpose in George Yard, Lombard Street. It became very popular, and in 1660 a tax of fourpence on the gallon was levied on all coffee made and sold. It spread amongst the English for reasons very similar to those which caused its spread among the Turks. According to Macaulay * it extended most rapidly. To be able to spend the evening sociably at a small charge soon became fashionable. The coffee-house was "the Londoner's home." Nobody was excluded who laid down his penny at the bar. There were such houses where politics were discussed, where literary men held their meetings, and where doctors, divines, and lawyers congregated, and might be consulted. "There were Puritan coffee-houses, where no

* "History of England, from the Accession of James II.," by Lord Macaulay, Vol I., p. 175.—People's Edition, 1864.

oaths were ever heard, and where lank-haired men discussed election and reprobation through their noses ; Popish coffee-houses, where good Protestants believed over their cups that the Jesuits were planning another Gunpowder Plot, and casting silver bullets, to shoot the king ; and Jew coffee-houses, where the money-changers of different nations greeted each other." Such was the respectable position of a London coffee-house in 1685. Lloyd's was originally a coffee-house at which insurers and underwriters met. These houses have long ceased to be the favourite haunts of literary men and fashion, and, although still retaining their ancient name, they are now on a level with an ordinary restaurant, having been superseded as places of entertainment by the numerous music-halls and club-rooms in the metropolis, where something more stimulating than coffee is usually in demand.

Coffee, like tea, is frequently adulterated. Of these adulterations the most common one is Chicory (*Cichorium Intybus*, L.), a plant resembling a dandelion, with blue flowers, belonging to the natural order *Compositæ.* The large tap roots of this plant are sliced and dried in kilns, they are then roasted and reduced to powder, and this, when boiled, yields a drink not unlike coffee. Chicory is perfectly wholesome, containing no alkaloid or oil, and only a small amount of narcotic matter. When added to coffee in small quantities, the oil is neutralised and rendered less difficult of digestion. The sale of chicory is now legalised. Many persons prefer the coffee with chicory.

The adulteration of coffee with chicory is easily detected. Roasted coffee imparts its colour very slightly to cold water, but chicory colours the water a deep reddish brown. Coffee is light, and floats on the surface of the water, chicory is heavy and sinks to the bottom.

Loheia and Mocha are the principal ports on the Red Sea for the exportation of coffee. Aden, acquired by

England in 1838, also exports the berry. East Indian coffee ranks next in commerce,—chiefly the produce of Ceylon and Batavia. For a generation past, the coffee plantations almost everywhere have been ravaged by disease, with the result that the berry is dearer in England now than before a heavy import duty was removed. Attention has been directed, consequently, to other sources of supply. A "Giant Coffee," from Liberia, has been introduced, which claims to be of a superior flavour, while yielding tenfold the crop, with less labour, and greater powers of "acclimating," with perfect freedom from disease. The berries are hard, large, and brown, and fetch a high price.

American coffees come from the free States of Venezuela and New Granada, from the Brazils, Cayenne, and Surinam. We export a little coffee to our colonies and Australia. Hamburg and Amsterdam are the most important markets, and next to these London, Rotterdam, Antwerp, Havre, and Trieste.

The values of the berries usually imported stand in the following order. Fine garbled Mocha from British India, fine Jamaica and Ceylon, Costa Rica, Brazil and Java.

Aden, *alias* Mocha coffee, is, like most of the Red Sea coffees, first sent to Bombay in Arab ships, where it is hand picked or garbled previous to being sent to England. The bean is single, broad, and small. The seed of the Berbera or Abyssinian coffee is called Long-berried Mocha. The Jamaica berry is medium sized, of a greenish blue colour, rather oblong and smooth to the touch. Ceylon berries are of irregular sizes, ill-shaped and of a spotted dirty cream colour. The Pea berry is of a shape implied by its name. "Plantation" and "native" coffees are terms applied to the Ceylon berries; the distinction arising from the one being the carefully cultivated and prepared berries

of the planters, and the other the wild or carelessly grown coffee of the natives around their habitations.

COCOA (*Theobroma cacao*, L.; natural order, *Byttneriaceæ*). A tree, about twenty feet in height, with dark-green leaves, from four to six inches in length, and about three inches in breadth; the flowers are small and white, growing directly both from the stem and branches; the fruit somewhat resembles a cucumber; about five inches in length, and three inches and a half in diameter, at first green, but when ripe yellow. Within this fruit, embedded in the pulp, are from forty to fifty cocoa-beans or seeds, packed closely together in five rows, around a common centre.

The cocoa trees will only grow well in the shade. They are planted at intervals of twelve feet apart, and are protected from the fierce heat of the tropical sun by the broad-leaved banana, and the stately and beautiful *Erythrina*, or coral tree. The rays of the sun cannot penetrate the foliage of these trees, and the ground below them is constantly wet. When the fruit is ripe, it is plucked and opened; and the beans, cleared of the spongy pulp, are spread upon mats to dry in the sun.

Chocolate and cocoa are both made from these beans. Chocolate is made by first freeing the beans from their husk, and then roasting them over a fire in an iron cylinder, with holes in its end for the escape of the vapour. The apparatus is very similar to that of a coffee-roaster. When the aroma is well developed, the beans are done; they are then turned out of the cylinder, and ground to a powder, which, mixed with sugar, flavoured with vanilla, and brought to a paste, forms the chocolate cakes of commerce. Cocoa is prepared by grinding up the entire nut—both husk and kernel—after roasting, depriving it of part of its fat during the process, so as to render it easier of digestion. Sometimes the beans are roasted and simply crushed. This

preparation is sold in the shops under the name of cocoa nibs.

The cocoa tree is a native of South America, Mexico, and the West Indies, where it formerly grew wild, but is now cultivated in extensive plantations. The beans of this tree have always been the chief means of nourishment to the natives of those countries. From them the Spaniards learnt to make both chocolate and cocoa. The range of cultivation now extends to Africa and Asia, by the transfer of living plants. Ceylon and Batavian cocoas, from their careful preparation, command a high market value, and shipments of an earlier date were made from the West Coast Settlements. The finest cocoa in the world is grown on a single farm in Guatemala, and is not exported.

The cocoa bean, which is about the size and colour of an almond, contains a peculiar solid oil called butter of cocoa, and an alkaloid called *Theobromine*, which produces on the nervous system analogous effects to those of *Caffeine* and *Theine*. Chocolate and cocoa yield highly nutritious beverages. Linnæus was so convinced of this that he called the plant *Theobroma*, the Drink of the Gods. Cocoa possesses more nutritive powers than tea or coffee and is really a gruel, or mixture, not merely an infusion.

Cocoa is imported into this country chiefly in the raw state, that is, the beans with the husks on. The following are the principal sorts which are brought into Europe. The preparation, "Chocolat Menier," is from cacao grown in the district of Rivas, Nicaragua. "Soconusco," the best sort, is from the district of the same name in the free state of Guatemala. This seldom comes into the market. Caracas, next in quality, from La Guayra, the commercial port of Caracas in Venezuela, also from Guayaquil in Ecuador. Our largest supplies are from these ports. We receive also heavy shipments from English, Dutch, and French

Guyana, the Brazils, Mexico, and the West Indies, especially from the island of Trinidad.

Although cocoa is by no means a national beverage like tea and coffee, the annual imports extend to hundreds of millions of pounds avoirdupois, and the consumption is only relatively small. In France, Spain, and Portugal, where chocolate is in request, the quantity consumed is constantly increasing, while it forms the ordinary breakfast of the Mexican race.

GRAPE (*Vitis vinifera*, L.; natural order, *Vitaceæ*).—The wines of commerce are mostly prepared by fermentation from the juice of the grape. The vine ranks with the tea and coffee plant in importance. The excellence of its fruit, whether fresh or dried in the form of raisins, is well known. The virtues of its fermented juice have been eulogised in song by poets, and its abuse has furnished a theme for moralists of every age and nation.

The grape varies in the colour, form, size, and flavour of its fruit. These varieties have all probably been produced by long-continued cultivation in different soils. The lengthened attention which the vine has received has given it an extensive geographical range. The vine may be found in all countries on the earth's surface included between the parallels of latitude 51° N. and 33° S. and in some favoured stations considerably beyond these limits. The same latitude does not always permit the fruit to ripen enough to make good wine; the degree of ripeness depends on the average clearness of the atmosphere throughout the year.

The vine is generally supported by props and trellises, but in the sandy districts of Spain it is allowed to trail upon the ground. The time of the grape harvest or vintage is always regulated by the character of the wine to be made. For a brisk wine, such as champagne, the grapes are gathered before fully ripe; for a dry, full-favoured wine, such as port,

the mature grapes are selected; and for German wines, the driest of all wines, the vintage is made as late as possible. The process of wine-making is as follows :—

The grapes are gathered into baskets, which are emptied into a tub, with holes at the bottom, called the wine-press. This tub is placed over another much larger, named the wine-vat. A man then gets into the upper tub and presses or crushes the grapes by treading upon them, a mode of bruising the grape as ancient as wine-making itself. The juice, or *must*, as it is termed, flows from the press into the vat, and sometimes within a few days, or even a few hours, depending on the temperature, begins to ferment. This fermentation makes the liquor turbid, increases its temperature and volume so that it soon fills the vat. After a time the fermentation ceases, the liquor diminishes in temperature and bulk, and becomes cool and clear. When quite cold it is drawn off, or racked, from the vat by a tap placed a few inches above the bottom, into an open vessel, whence it is conveyed into the casks prepared for its reception. After entering the cask, a second although much slighter fermentation takes place, which further clarifies the wine; its subsidence diminishes the bulk of the wine in the cask, and more wine is added so as nearly to fill the cask. This again slightly renews the fermentation, and the cask is kept open until filled to its utmost capacity with wine free from fermentation; it is then closed and is ready for the market.

Great attention and practical skill are required to manage the fermenting process properly, as on this depends the quality of the wine. Wines vary according to the amount of sugar, alcohol, and acid which they contain. When wines contain much sugar, they are called "sweet," when little, "dry." Sweet wines, such as Malaga and Tokay, are wines which have been only half fermented; their sweetness

depends on the fermentation not having exhausted the sugar. Dry strong wines, such as Madeira, Sherry, Marsala, and Port are fully fermented wines, all the sugar of the grape having been converted into alcohol. Champagne and other sparkling wines owe their briskness to the presence of carbonic acid; whilst Hock and the Rhenish wines generally, and many of the French, contain much uncombined acid. The roughness and flavour of the red wines are usually derived from the husks of the fruit, but are often communicated to them by the addition of astringents, such as rhatany, or kino. The tints of wines are either natural or artificial. Their strength is frequently augmented by the addition of brandy. This brandy is itself distilled from wine. It is coloured with burnt sugar, and peach kernels are added during the distillation to give it that peculiar flavour by which it is distinguished.

The principal wine countries in Europe are France, Spain, Portugal, Germany, Sicily, Italy, Hungary, Greece, and Turkey.

France holds the first rank. The principal French wines are white and red Champagne, white and red Burgundy, white and red Medocs from Bordeaux, Rhone wines, and wines from Languedoc, Roussillon, Orleans, Beaune, and Corsica. The inferior white wine of Bayonne, and Bordeaux wine, pass under the name of *vin ordinaire*.

From Germany we receive the celebrated Rhine wines, so called from their place of culture, the valley of the Rhine and its tributary streams; wines from the Palatinate, principally from Rhenish Bavaria; wines from the Bavarian province of Lower Franconia; Moselle wines from Rhenish Prussia; and Tauber wines from Baden and Wurtemberg. The chief places for these wines are Mayence, Coblentz, Frankfurt-on-the-Main, and Wurzburg.

The vine is cultivated to some considerable extent on

the Danube in Lower Austria, also in Tyrol and Illyria; but the exportation is small. Moravia, Silesia, Bohemia, and Saxony grow inferior wines. Artificial champagne is made in many parts of Germany, especially at Esslingen, Stuttgardt, and Mayence.

The best *Swiss wines* are the Ryff wines, from the Canton de Vaud, the *Vin de la côte* from the shores of Lake Geneva. Of *Hungarian wines*, Tokay is the chief, and is largely exported to Moravia, Silesia, Poland, and Prussia. Of *Spanish wines*, Malaga and Alicante are the most valued, and called after the names of the places which export them. From Oporto in Portugal we receive red and white port wine. Numerous varieties of Italian wines come into commerce Europe also obtains Madeira wine from the Island of Madeira, on the north-west coast of Africa, Cape (Constantia) wine from the Cape of Good Hope, and Palm wine from the East Indies. Young and inferior wines, and the lees of wine, or the sediment at the bottom of the wine-vat, are used in the manufacture of Cognac, or French brandy, and vinegar; these come into the market from Bordeaux.

The southern hemisphere, the physical counterpart of the grape-zone, produced no wines until British settlers tested the capability of the climate and soil. A large vintage has since enriched the Cape; and, still more recently, Australia has entered the field of production with such success, that its wines formed one of the most striking features of the Indian and Colonial Exhibition of 1886.

HOPS (*Humulus Lupulus*, L.).—The hop vine, so well known in England, is a native of Europe, and is probably also indigenous in North America, as it has been found growing apparently wild on the banks of the Mississippi and Missouri. It is extensively cultivated for its strobiles or cones, so largely employed in the preparation of malt

liquors. These strobiles, or female catkins, when fully ripe, are picked from the vines, dried in kilns, and packed in bags. Hops consist of thin, translucent, veined, leaf-like bracts or scales, of a greenish-yellow colour, having near their base two small, round, dark seeds. Hops are somewhat narcotic and their odour fragrant, the taste bitter, aromatic, and slightly astringent. These properties are owing to the presence of a peculiar resinous secretion in the glands, which has been called "lupulin." Ale and porter owe their bitter flavour and tonic properties to the hops added to them during the process of brewing—about one pound of hops being added for every bushel of malt. The importation of hops is chiefly from the Hanse Towns, Holland, Belgium, and the United States. Some parcels of splendid quality have been received from Australia. Hops were not used in the making of beer until the end of the Middle Ages. The beer of earlier times was a very different beverage from that which we now drink. The hop is an example of a plant which, under cultivation, develops its economic properties by transference from its native home, where it grows wild and rank.

## VI.—Plants Producing Wholesome and Nutritious Fruits.

The fruits of commerce are very numerous and interesting. They come to us from almost every climate and country; an immense amount of shipping is engaged in bringing them across the seas, and employment is thus given to hundreds of thousands of people. Besides furnishing us with nutritious food, these fruits give us much novel and interesting information in regard to the economy of vegetation in foreign countries. With our rapid steamers and our improved modes of preserving perishable substances

during their transit, we are approaching the day when the fruits of every clime will reach us in a fresher state and render us independent of the seasons. They are arranged naturally into two divisions:—

### *A. Fleshy Fruits.*

Of these one of the most important is the

SWEET ORANGE (*Citrus aurantium*, Risso; natural order, *Aurantiaceæ.*).—This is one of our commonest foreign fruits. The orange tree is a medium-sized evergreen, with bright-green leaves, furnished with winged footstalks; the flowers are white and very fragrant. Both the ripe and unripe fruits are frequently seen on the tree at the same time along with the flowers—their presence amongst the foliage adding greatly to its beauty. China is generally considered to be the native country of the orange tree, where it still grows wild. Brought to Portugal about 1520, it has thence been transplanted into every country possessing climate suitable for its culture, and is now grown in China, Portugal, India, Northern and Southern Africa, Southern Europe, Turkey, the islands of the Mediterranean, the Azores, the West Indies, and the Southern portion of the United States.

The oranges imported into this country come from the Azores, Lisbon, Malta, Italy, Sicily, and Spain, in boxes and chests. A single orange tree in St. Michael's has produced a crop of 20,000, exclusive of those unfit for use, calculated at 10,000 more. Millions of bushels of oranges and lemons are imported into the United Kingdom.

The rind of the orange yields by distillation a fragrant oil much used in perfumery; a still more agreeable oil, with which eau-de-Cologne is perfumed, is distilled from orange flowers. The rind is also boiled in sugar until it is candied, and thus converted into a sweetmeat. The orange contains much saccharine matter and mucilage, forming an agreeable

acid, and hence is wholesome, cooling, and refreshing to the sick, especially in cases of fever and inflammation.

The Bitter, or Seville Orange (*Citrus bigaradia*, L.)—This species resembles the sweet orange, but is easily distinguished by the bitterness of its fruit. These oranges are chiefly used in making marmalade. The rind has a place in the British Pharmacopœia from its qualities as a tonic.

Citron (*Citrus medica*, L.)—The citron approaches the lemon tree in appearance, with which it has sometimes been confounded. The chief difference is in the superior thickness of the rind of its fruit. The fruit of the citron sometimes attains a very great size, weighing upwards of twenty pounds. The citron itself is not eaten, but the thick rind is much used as a preserve, and reaches England either already candied or else pickled in salt and water for the purpose of being candied on its arrival. We receive annually from Madeira many tons of this preserved rind. An essential oil is obtained from the rind of the citron, very fragrant, and used in perfumery. The citron spread from Persia into Europe through the Arabs.

The Lemon (*Citrus limonum*, L.)—This plant is a native of the Himalaya mountains. It appears to have been brought to Europe about the time of the Crusades. The lemon is now cultivated in all warm climates. The principal supplies to our markets are received from Italy, Spain, Portugal, Trieste, and South Tyrol. The juice and rind are both officinal or trade commodities. Lemon juice is grateful and cooling, and is much used in the preparation of effervescing draughts, and as a beverage in febrile complaints. The juice owes its sourness to the presence of a peculiar acid, called *citric*, which is easily separated by chemical means. It is one of the most powerful antiscorbutic medicines known. That dreadful disease, the

scurvy, has hardly been known in our navy since the juice of limes and lemons has been ordered by law to be carried by all vessels sailing to foreign parts.

There are several other species of *Citrus* which are largely imported; as, for instance, the *Citrus limetta*, or lime, which is about one-third the size of a common lemon, and which is exported in the green state, in order to preserve the delightful aroma of its rind. The preserved lime comes to us in small kegs of about 7 lbs. weight. The *Citrus Bergamiæ*, or Bergamot, bears a fruit closely resembling the lemon. As a preserve it is used as a substitute for citron, but its chief value lies in the oil obtained from it—the well-known bergamot so much used in perfumery.

GRAPES (*Vitis vinifera*, L.)—The fruit of the vine not only furnishes us with a variety of wines, but is itself imported into this country both in the fresh and the dried state. We receive comparatively few grapes in a fresh state though hundreds of tons arrive every autumn from Sicily, Lisbon, and Hamburg. They suffer in quality and their flavour is in a measure absorbed by the sawdust in which they are necessarily embedded. Raisins, or dried grapes, are far more abundantly imported. These are prepared sometimes by cutting the stalks of the bunches half through, and leaving them suspended to the vine until sufficiently dry, which in this state they rapidly become, without losing any of their fine flavour or bloom; the usual mode is to expose the grapes to the sun and air for a while, then lay them out in rooms, and sprinkle them with water in which soda or potash has been dissolved. This causes the sugar of the grape to candy, forming those little sweet lumps so well known in the common raisin. The differences amongst the raisins are caused both by geographical conditions and by the varied modes of culture and curing. Thus we receive stoneless Sultana raisins from

Smyrna, in the Levant; fine Muscatels, or sun-dried raisins, in bunches with the stalks still attached, from Malaga; Damascus raisins, much larger than the Sultanas, stoneless also, and preferred to the Smyrna raisins, from Damascus; and lastly, the ordinary raisins from Valencia, and from the same countries and ports where the grape is cultivated.

Currants are only the raisins of a small grape, also deficient in seeds or stones, growing in huge bunches, often as much as eighteen inches long, and of proportionate breadth. They are dried, trodden into large casks, and exported. Enormous quantities are cultivated in the Grecian islands, principally in Corfu, Zante, and Ithaca. Originally, Corinth was the principal place where they were raised, whence the name "Corinths," from which the word "currants" has been derived. Many millions of tons of this esteemed fruit are imported, with about half as much of the larger varieties of raisins. The fresh fruits are timed to arrive for the festivities of Christmas, when the national plum-pudding is in favour in every home.

FIG (*Ficus carica*, L.; natural order, *Urticaceæ.*)—The "sister of the vine," as the fig has been graphically called, is a very valuable and extensive genus of tropical and subtropical plants, some of the species attaining an enormous size, as the *Ficus Indica*, or celebrated banyan tree. The fig tree, originally a native of Syria and Palestine, flourishes in Southern Europe, on all the islands in the Mediterranean, and especially in Asia Minor, Northern Africa, and the Canary Islands.

The fig, considered botanically, is a very remarkable form of fruit, being just the reverse of that of the strawberry, in which the minute carpels are scattered over the exterior of the enlarged succulent receptacle; whereas in the fig the inflorescence or position of the flowers is concealed within the body of the fruit. There is sometimes

a failure in the fig crop, when it is not properly attended to, in consequence of the pistils of the florets not becoming duly fertilised by the pollen of the stamens. It is supposed that this operation is caused by the entry of insects through the very small orifice which remains open in the flowering fig; the fig-growers therefore adopt an artificial means of ensuring fertilisation. A small feather is inserted and turned round in the internal cavity. This operation is called "caprification."

Figs are sent to us in large quantities from Turkey and Greece. After having been gathered from the trees and dried in the sun, they are packed in square or circular boxes, the latter being called drums. A few bay leaves are put upon the top of each box, to keep the fruit from being injured by a grub, which feeds on it and is very destructive. The Maltese figs are very good, but those which come from Smyrna, called "Eleme," or "Elemi," are the best.

The fig is nutritious, laxative, and demulcent, acting gently in cases of habitual constipation. Roasted and split it is sometimes applied to gum-boils and other circumscribed maturating tumours. It was used by Hezekiah as a remedy for boils 2400 years ago. (*See* Isaiah xxxviii. 21.)

In Italy, figs, both fresh and dried, are the common food of the people. With a southern and sheltered aspect, they ripen even in England. The wood of the tree becomes as dense as the oak when dried and seasoned, but while in the sap, is soft, spongy, brittle, and commercially useless.

PRUNE (*Prunus domestica*, variety, *Juliana;* natural order *Rosaceæ*).—Dried plums, under the names of prunes and French plums, form an important article of commerce. Prunes are the Julian variety of the common plum dried in the sun, then thrown together and pressed into barrels. We receive them in large quantities from France.

*Prunus domestica*, variety *Catherinea*, is the French plum or table prune. These are more carefully prepared for market. They generally come over in very elegant boxes called "cartons," into which they are neatly packed one by one. Whole forests of plum trees prevail in the Balkan States, where, during the season, the produce forms the national food; something more is consumed in the shape of plum-brandy, *slivovica* or *raki*.

THE DATE PALM (*Phœnix dactylifera*, L.)—This palm has been known and prized from the earliest antiquity; it is frequently referred to in the Bible. The fruit is very nourishing and wholesome, and grows in bunches weighing from twenty to twenty-five pounds. Every part of this tree is useful. Its hard wood is employed for building; its leaves are made by the natives into mats, baskets, and drinking bowls of great neatness; its seeds are ground to make oil; and its fermented sap forms an excellent wine.

In Corsica, Sardinia, and in Southern Greece the date palm is planted only as an ornamental tree, as its fruit does not mature in these parts, or ripens only imperfectly. In the very warmest districts of Spain, around Valencia, the fruit comes to perfection, and is exported. The date palm is indigenous to Arabia and northern Africa, where it is very abundant. In those countries plantations of these trees are sold as estates, and are often the wedding portion of the bride. In some parts of Arabia this palm sometimes forms almost impenetrable forests when neglected by the Arab of the desert, who usually considers every kind of cultivation beneath his dignity. More frequently, however, it is found near solitary springs, thus presenting to the thirsty traveller a welcome signal, which assures him of water for refreshment, and of a friendly shade for repose. "The king of the oasis bathes his feet in water and his head in heaven's fire."

The best dates come to us from Tunis *viâ* Marseilles. They are commercially known as Tafilet dates, the richest in sugar of all kinds.

POMEGRANATE (*Punica granatum*, L.; natural order, *Myrtaceæ*).—A small evergreen shrub, resembling a myrtle, with slender branches; flowers large, and of a rich crimson colour. The fruit is about the size of a large poppy head, and similarly shaped; its rind hard, leathery, and beautifully coloured; when ripe, golden yellow, with a rosy tinge. When the rind is broken, the interior of the fruit is found to be filled with numerous seeds, each enveloped in a rose-coloured pulp, packed together in two rows, with partitions of pith between them, and closely resembling red currants.

There is scarcely a part of the pomegranate that is not either useful or agreeable. The pulp of the fruit is refreshing to persons suffering from fever. The seeds and flowers dried form a valuable medicine, and are used in dyeing, and the rind is employed in tanning and preparing the finer kinds of leather, as the morocco, so much used for binding books.

The pomegranate is a native of Northern Africa, Syria, and Persia, but it is now naturalised in the warmer parts of Europe, the West Indies, and the Southern States of the American Union. It was well known to the ancients, is mentioned by Homer, and frequently referred to in the Bible. We receive annually a considerable number of chests of pomegranates from Portugal, and sometimes from Barbary. This tree is frequently cultivated as much for the beauty of its flowers and foilage as for its fruit.

TAMARIND (*Tamarindus Indica*, L.; natural order, *Leguminosæ*).—This is a large tree, with spreading branches, the leaflets closing in the evening or in cold, moist weather, like those of the sensitive plant. The flowers are succeeded

by an oblong, compressed, one-celled, brittle, brown pod, from three to four inches in length, which encloses from six to twelve brown, flattened, hard, polished seeds, enveloped in a soft pulp, the whole being held together by a number of thick root-like fibres which penetrate it in all directions.

The tamarind is common in the East Indies, where it is indigenous, and grows in great perfection. It is now extensively cultivated in the West Indies and in South America; but the fruit there is not equal to the East Indian, having much less saccharine matter in the pulp. The tamarinds from the East Indies are darker, have a larger and sweeter pulp, and can be preserved without sugar; those from the West Indies require sugar, and are sent over preserved in a thick saccharine syrup.

The tamarind pods are gathered when ripe, a fact known by their brittleness; the fruit is removed from the pod, placed in layers in a cask, boiling syrup is poured in, and when the cask is filled, and its contents have cooled, it is headed down for exportation.

In tropical countries the tamarind is much esteemed for its cooling qualities; its taste is acid and agreeable and it assuages thirst. Tamarinds are principally employed in this country to form cooling medicinal drinks. Large quantities arrive annually from the East and West Indies.

BANANA (*Musa sapientum*, Tournef.; natural order, *Musaceæ*).—This may be called a stemless plant, for its gigantic leaves, with their long petioles, are sheathing and imbricated at their base, and form, by their union, a spurious trunk, often many feet in height. The leaves are from four to six feet in length, rounded at each end, and about eighteen inches in breadth through their whole extent; they have a strong mid-rib, parallel, lateral veins, and are of a beautiful emerald green colour. The flowers

produce large clusters of succulent indehiscent fruits, each fruit being an inch in diameter and about six inches in length. When ripe, the banana acquires a rich golden yellow colour; the outer envelope or exterior of the fruit is easily removed; the inner portion consisting of a rich cream-coloured pulp, containing much sugar and starch. The banana forms an important article of food in the tropics. Some idea of its fruitfulness may be gathered from the statement of Humboldt, that the same space of ground which will grow thirty pounds of wheat, or ninety-nine pounds of potatoes, will afford 4000 pounds of bananas. Those intended for exportation are gathered green and unripe, but soon acquire, on being kept, that golden tint which marks maturity. Several other species of *Musa* produce similar fruits. *Musa paradisiaca* yields the plantain, a fruit bearing a close resemblance to the banana, and equally nutritious, being cooked and served at meals as a potato.

PINE-APPLE (*Ananassa sativa*, Lindl.; natural order, *Bromeliaceæ*).—This is a stemless plant with rigid leaves. The fruit is called in botany a *sorosis*, and consists of a union of the ovaries, floral envelopes, and the succulent axis of the inflorescence, which become pulpy and confluent with each other. The fruit is so acid in the wild state that when eaten it removes the skin from the lips and gums; cultivated, it becomes sweet and richly aromatic.

Originally indigenous to the Bahama and Bermuda Islands, the pine-apple, owing to its value as a fruit, and its capability of becoming naturalised, is now cultivated, not only in the East Indies and Africa, but in all parts of the world where it can be grown either by natural or artificial means. Through the introduction of steam navigation, vessels can now bring ripe pine-apples from the West Indies to England in pretty good condition; and their importation has become an extensive trade, more than 200,000 having

been brought from the Bahamas in one year. Consequently, this fine fruit is often sold in London and other large towns at a cheap rate compared with the price asked for those grown in English hot-houses. English-grown pine-apples are worth from ten to twelve shillings per pound, whilst those imported rarely exceed half a crown for the whole fruit.

### *B.—Nuts.*

HAZEL NUT (*Corylus Avellana*, L.; natural order, *Cupuliferæ*).—This familiar edible nut is found growing wild in the United Kingdom, in the forests of all parts of temperate Europe, and in many places in Asia. The consumption is immense, especially amongst children; and many thousand bushels are annually brought to this country from Spain, Sicily, Smyrna, and other places. The filbert is only an improved variety of the common hazel nut, and although occasionally imported, is usually cultivated in sufficient quantities in England to supply the demand.

WALNUT (*Juglans regia*, L.; natural order, *Juglandaceæ*). This fine tree is too well known to need description. It grows not only in England, but over the whole of Europe, and in Asia. It is especially abundant in Circassia, where it is extensively cultivated. There is a considerable number of English walnuts in the market, as the fruit ripens well in the southern parts of this country. We receive about 30,000 bushels of foreign walnuts annually, chiefly from Germany, France, and Italy. Walnuts will not bear a long voyage without being kiln-dried, a process which preserves them from decay but spoils their freshness and flavour.

HICKORY and PECAN NUTS.—We receive from the United States, in small quantities, the hickory nut (*Carya alba*, Nutt.), and the pecan nut (*Carya olivæformis*, Nutt.), both of which belong to the same natural order,

*Juglandaceæ.* These nuts have kernels similar to those of the walnut, but their shells are very different. The hickory nut is smooth, whitish, marked on its exterior with three or four elevated ridges, extremely hard, and smaller than the walnut. The pecan nut is about the size of an olive, which it resembles in shape, as implied by its specific name; its colour is a light reddish-brown.

BRAZIL NUT (*Bertholetia excelsa*, Humboldt; natural order, *Lecythidaceæ*).—Large fine trees, often 120 feet in height, and growing abundantly in the Brazilian forests. The nuts are closely packed in a hard woody capsule, to the number of twelve or twenty. This capsule is nearly round, but slightly pear-shaped, and is so hard and heavy that when it is ripe it is dangerous to pass under the trees, for a human head is not thick enough to escape fracture if struck by one of these fruits in falling. The capsule or pod is the size of a small melon, and is allied to the so-called monkey-pot, with a shell harder to fracture than that of the cocoa-nut. The monkeys wait for the fruit to ripen and fall, when it often bursts open. This is at once the signal for an amusing scramble amongst the monkeys, who, keeping sentinel on a hundred branches, instantly swing themselves from tree to tree by the help of their prehensile tails, until they arrive at the spot, and then fight furiously for the coveted nuts. Belonging to the same order are the *Sapucaya* nuts (*Secythis ollaria*), with a pod of about the same size as that of the Brazil pod, but provided with a circular lid. These and the *Suwarri* nuts, both of which enter to some extent into British commerce, are choicer fruits than the Brazil nut.

CHESTNUT (*Castanea vesca*, L.; natural order, *Cupuliferæ*).—The chestnut tree is a native of Great Britain and the temperate parts of Europe, but the nuts not coming to much perfection in this country, we import them from Spain,

whence they are usually called Spanish, though they arrive chiefly from Bordeaux. Although not very nutritious, chestnuts are much more easy of digestion when roasted. The larger and better sort called Marones are the produce of Italy, France, Switzerland, and of some parts of Germany.

THE SWEET ALMOND (*Amygdalus communis*, L.; variety, *dulcis*; natural order, *Rosaceæ*).—The almond tree, a native of the warm parts of Asia, and of the coasts of Barbary, is now cultivated to some considerable extent in Southern Europe, especially in Italy and Spain. It grows to about the size of a common plum tree. The cortex or outer envelope of the fruit is not succulent like the peach (*Amygdalus Persica*, L.), to which the almond is allied, but hard, green, and juiceless, so that when growing it looks not unlike an unripe apricot; when fully ripe this green covering splits, and the almond in its rough shell drops out. There are two well-marked varieties of the sweet almond. 1. The Jordan almonds, the finest and best of the sweetest variety; these, notwithstanding their Oriental name, we receive from Malaga, imported without their shells. 2. The Valencia almonds, are broader and shorter than the Jordan variety, and usually imported in the shell. The almond tree blossoms in England early, but bears no perfect fruit.

BITTER ALMOND (*Amygdalus communis*, L.; variety *amara*).—This variety comes to us from Barbary, in Northern Africa, where it forms a staple article of trade. It is principally used for its oil, which imparts a pleasant flavour to confectionery. This almond is smaller and much rounder than the two preceding varieties of sweet almond, and very bitter to the taste.

### *Natural Order Palmaceæ, or the Palm Family.*

The palms, next to the cereal grasses and sugar-cane, are the most valuable order of food plants. They are, however,

of far greater importance in the countries where they are produced than in our own, furnishing as they do to the inhabitants of those countries food, shelter, and clothing. The most useful plant of this order is :—

The Cocoa-nut Palm (*Cocos nucifera*, L.)—This palm supplies the natives of the countries in which it grows with clothing, food, medicine, houses, and every description of domestic utensil. The aspect of the tree is very imposing. Its stem is tall and slender, without a branch, and at the top are seen from ten to two hundred cocoa-nuts, each as large as a man's head; over these are the gracefully drooping, green, glossy, and beautiful pinnate leaves. "The blessings it confers are incalculable. Year after year the islander reposes beneath its shade, both eating and drinking of its fruit; he thatches his hut with its boughs, and weaves them into baskets to carry his food; he cools himself with a fan plaited from the young leaflets, and shields his head from the sun by a bonnet of its leaves; sometimes he clothes himself with the cloth-like substance which wraps round the base of the stalks, whose elastic rods, strung with filberts, are used as a taper. The larger nuts, thinned and polished, furnish him with a beautiful goblet, the smaller ones with bowls for pipes; the dry husks kindle his fires, their fibres are twisted into fishing lines and cords for his canoes. He heals his wounds with a balsam compounded from the juice of the nut, and with the oil extracted from it embalms the bodies of the dead. The noble trunk itself is far from being valueless. Sawn into posts, it upholds the islander's dwelling; converted into charcoal, it cooks his food; and supported on blocks of stone, rails in his lands. He impels his canoe through the water with a paddle of the wood, and goes to battle with clubs and spears of the same hard material." *

* Melville's "Adventures in the South Seas."

The cocoa-nut palm grows by the sea-side in most tropical countries, and is usually the first plant to establish itself on the newly-formed coral reefs in the Pacific and Indian oceans. It is abundant throughout the South Sea Islands. The fibrous outer covering of the nut, when macerated and prepared, is termed "coir," a substance much used for making ropes, mats, and stuffing for cushions (see p. 226). Large quantities of oil are obtained from the cocoa-nut. The whole dried kernel brought from Ceylon, is known in British commerce as coprah or coperah. This oil has of late years been in great demand in England for the manufacture of composite candles and soap. Marine soap, so called because it washes linen with sea-water, is made from cocoa-nut oil. This nut is used largely in confectionery. The cocoa-nut forms a considerable article of export from many of our colonies. Besides the commercial value of the cocoa-nut for its fruit and oil, the milk, or sweet watery fluid inside the young nut, is refreshing as a beverage. The kernel is an admirable addition to curries. Cocoa-nut, rice, and a few vegetables, with occasionally fish, form the sole food of oriental millions. To this fare the Chinese add pork and sea-weed jelly.

## VII.—Miscellaneous Food Plants.

Onion (*Allium cepa*, L.; natural order, *Liliaceæ*).—The onions of Spain and Portugal and the south of France are superior to our common garden onion, larger, milder, and more succulent. Italy and Malta send many chests and boxes. Some, entered as Spanish, are Italian onions. The varieties of the onion tribe are as numerous as the range of growth is wide. Its home coincides with the region of oil and wine, which might equally be called the zone of bulbs. Since the wandering Hebrews sighed in the desert for the

garlic of Egypt, this esculent has ever been the poor man's condiment. The nations of the Mediterranean are the garlic lovers, while chives and shallots (*eschallot*) are characteristic of France, and the leek is the national emblem of Wales. The races round the German Ocean have been distinguished from those of the South as garlic haters.

SOYBEAN (*Soja hispida ;* natural order, *Leguminosæ*).—A sauce or catsup, as thick as treacle and of a clear black colour, called Soy, which is much esteemed, is made from the beans of this plant by the Chinese, and sent to us from India in considerable quantities. The beans are imported into Europe as a forcing food for milch cows.

TRUFFLES (*Tuber cibarium;* natural order, *Fungi*).—These fungi grow beneath the soil, generally in beech woods, in this country somewhat sparingly, but more plentifully in France and Italy, and are highly prized for their delicate flavour. In form the truffle is round, its surface in some species smooth, in others warted and tuberculous; the colour, dark brown outside, and brown, grey, or white within. They generally grow at the depth of five or six inches. Dogs are trained to scent them out, and sows are also employed for the same purpose. We receive them from France and Italy preserved in oil. They are used in sauces and soups, and as stuffing for poultry. Some are imported in a fresh state.

MOREL (*Morchella esculenta*, Dill.)—This is one of several fungi found in this country which may be eaten with safety. The stipes or stalk is hollow, from two to three inches high; the pileus or cap is spheroidal, hollow within, and marked on the surface with numerous areolæ, resembling a honeycomb in structure; the colour whitish.

The morel is usually found abundantly where trees have been burnt, a fact which led in Germany to the practice of firing the forests for the sake of the morels, a practice so in-

jurious that it became necessary to suppress it by law. This fungus occasionally occurs in woods and orchards in England, whence it finds its way to our markets; it is valuable for cookery purposes, but is more frequently used in a dry state for sauces than when fresh. We import morels from Italy.

MUSHROOMS.—Of greater importance than *morels* are the mushrooms of our autumn meadows and fields, where they grow abundantly and furnish a substantial addition to our food. Many more of the fungus tribe are wholesome, but are feared from want of the knowledge to distinguish them from poisonous varieties.

CARRAGEEN OR IRISH MOSS (*Chondrus crispus;* natural order, *Algæ*).—This is a very common plant on the rocky coasts of Ireland and Great Britain. The frond is tufted, fixed to the rock by a hard base, the segments crisped and curled at the edges. The whole plant looks like yellow parchment.

Carrageen or Irish moss contains an abundance of mucilage, and is extensively used for feeding cattle, and for forming a light nutritive jelly for invalids, nearly the whole weight of the plant being convertible by boiling into the required substance. Carrageen moss is sometimes used in manufactories for dressing silks. Immense quantities of it are annually brought to England from the Irish coast, and from Northern Europe. Iceland moss, the food of the reindeer, like carrageen, serves for various economic purposes. A sea-weed, known as Chinese and Japanese isinglass, has grown into importance as a commercial commodity.

## SECTION II.—INDUSTRIAL AND MEDICINAL PLANTS.

### I.—Textile Plants, or Plants from which we derive Clothing and Cordage.

We are indebted to the vegetable kingdom for clothing as well as food. At what time man first discovered the means of forming articles of clothing from the fibre of plants is not known, but the practice is very ancient. It was understood in the time of the Pharaohs, more than 1600 years before Christ. Flax is thus alluded to in Gen. xli. 42 :—"And Pharaoh took off his ring from his hand, and put it upon Joseph's hand, and arrayed him in vestures of fine linen." It is not improbable that flax was cultivated in prehistoric periods. It formed both the garments and grave clothes of the inhabitants of ancient Egypt; for the microscope shows that the cere-cloth which envelopes the Egyptian mummies, consists of the fibre of flax. We place it first on our list of textile plants, as the one of which we have the oldest historic record.

Common Flax (*Linum usitatissimum*, L.; natural order, *Linaceæ*).—This plant is a smooth fibrous-rooted annual, about two feet high, with terminal blue flowers. Ovary globular, five-celled, each cell containing two smooth, oval, brown, and glossy seeds.

Flax has a remarkable geographical range, thriving in the temperate, sub-tropical, and even tropical regions. It is not only cultivated in the United Kingdom, but in every part of Europe, in Egypt, and in India. Formerly every rural family in England cultivated as much flax as was required for domestic purposes; now the spinning wheel has been superseded, and both linen and cotton goods are manufactured by steam machinery, in every variety of pattern, and with much less time and labour.

The cultivation of flax fibre goes back beyond human records. Egyptian mummy cloths remain to prove the unsurpassed excellence of the linen fabrics of the country of the Nile. To be clothed in fine linen was a sign of sumptuous life, and to the present day, the fabrication of linen or its use marks every civilised race.

To obtain the fibrous or woody tissue of flax, the plants, after flowering, are first pulled up, dried in the sun, collected, and soaked in water to destroy their green outer bark. This process is called water-retting, the word retting being a corruption of rotting. The tough fibres of the stalks, thus set free, are again dried, and scutched or beaten with a heavy wooden instrument, which completes their separation. After this they are heckled, or drawn through the gills or teeth of the combing apparatus, next bleached, and, lastly, handed over to the spinner.

From flax so prepared, linen fabrics are manufactured; but the flax must be heckled several times through much finer combs to render it fit for the manufacture of fine linen, lawn, or lace. Tow consists of the rough and broken fibres detached from the skeins during the combing process. Linen when scraped is termed lint, in which form it is very valuable to the surgeon as a dressing for wounds.

Flax, dressed and undressed, is imported into the United Kingdom chiefly from Russia, Egypt, Turkey, Italy, Belgium, and Holland. We also raise flax ourselves, especially in Ireland, where it is one of the staple commodities. In 1851, Chevalier Claussen patented a method of cottoning flax, which was successful so far as the process went, but little result has followed, commercially.

HEMP (*Cannabis sativa*, L.; natural order, *Urticacæ*).—The hemp-plant is a tall roughish annual, from five to ten feet in height, belonging to the tribe of nettles. It was unknown to the earliest races as a source of textile fibre, no

allusion being found in Egyptian, classical, or Biblical records. Hemp grows luxuriantly wild in Bactria. The Scythians intoxicated themselves with a preparation from its seed, as the Hindoos now do. The seed is produced in great abundance, and is used for feeding small birds. The fibres of the stem are much longer and stronger than those of flax, and when prepared in a manner very similar to that adopted with flax, constitute the hemp of commerce, from which sail-cloth, sacking, and every variety of cordage are manufactured.

The hemp-plant is a native of Persia and of the northern parts of India, whence it has been introduced into Europe, where it is now cultivated, especially in Russia. Like flax, hemp has a very extensive geographical range, growing in almost any country and climate. It thrives admirably in North America and in Africa, and is found from Northern Russia to tropical India.

When growing in warm countries the value of the hemp fibre is much diminished, and another quality developed. The plant becomes powerfully narcotic, and its leaves, flowers, and stem become covered with a peculiar resinous secretion called *churrus* in India. By the Arabs this resin is called *hashash*, and during the Crusades, men intoxicated purposely with it, called "hashasheens," used to rush into the camp of the Christians to murder and destroy, whence our word assassin is derived. Hemp is employed in other forms besides churrus as a narcotic. The whole herb, resinous exudation included, is dried and smoked under the name of *gunyah* or *bhang*, when the larger leaves and capsules only are employed. The Hindoos, and the Bushmen of Southern Africa, smoke these preparations in rude pipes, as we do cigars and tobacco. These pipes are about three inches in length, and are usually made out of the tusk or canine tooth of some animal, perforated through,

leaving only the enamel. Churrus or charus is properly excluded from medicine, though regarded as of great importance by Asiatic nations. It is prepared as a confection, consisting of the hemp resin with sugar, almonds, and various ingredients. Strong coffee is the best antidote to its effects. Hemp oil is a constituent of Russian food.

From experiments made with churrus, it would seem that the fakeers and other religious devotees of India, are indebted to it for their ability to perform some of their wonderful feats.

The narcotic hemp of warm climates was thought to be another species, but it is only a variety, distinguished as *Cannabis sativa*, variety, *Indica*.

The imports of hemp into the United Kingdom are chiefly from Russia, Hungary, Austrian Italy, the Philippine Islands, and British India. The best Hungarian hemp comes from the district of Peterwardein, under the name of Sclavonian hemp. From Italy we receive a remarkably fine variety, raised by spade culture, called "Italian garden hemp."

In addition to sail-cloths and cordage, a coarse brown paper is made from hemp. Oakum consists of tarry hemp, procured by untwisting old worn-out ship ropes, and is invaluable for caulking or filling in between the timbers of a vessel in course of building, or for stopping leaks at sea. With iron vessels oakum is of no practical utility.

COTTON WOOL (the woolly covering of the seeds of several species of *Gossypium*; natural order, *Malvaceæ*).—Much uncertainty prevails as to the number of species of *Gossypium* which furnish cotton. Linnæus has described five, Lamarck eight, Wildenow ten, and De Candolle admits of thirteen. The cotton of commerce, which consists of the hairs attached to the seeds, appears to be derived from three species, designated as the cotton herb (*Gossypium herbaceum*,

L.), the cotton shrub (*Gossypium Indicum*), and the cotton tree (*Gossypium arboreum*).

1. COTTON HERB (*Gossypium herbaceum*, L.)—The greatest amount of cotton is derived from this species, which is the best known and most widely spread. It is an annual, and cultivated in the United States, India, China, and many other countries. It grows from three to four feet in height, having three to five alternate leaves, and pale yellow flowers resembling those of the mallow.

After the plant has done flowering, a capsule is formed. This capsule grows to the size of a walnut, turns brown as it ripens, and then dehisces or opens, displaying in its three-celled interior a snow-white or yellow down enveloping the three seeds lying in each cell; altogether, nine cotton balls may be collected from each capsule, each ball with its enclosed seed being about the size of an ordinary grape.

Chinese Nankin cotton is manufactured from a variety of this plant. The yellowish brown colour of the nankin is not artificially produced by dyeing, but is the natural colour of the cotton.

2. THE COTTON SHRUB (*Gossypium Indicum*, Lamarck).—The cotton shrub is cultivated in India. It closely resembles the former plant in many respects, but it grows from eight to twelve feet high; its flowers change from white to red, and its capsules are ovoid. The cotton shrub is cultivated in all countries where the cotton herb is found. In the West Indies this plant lives from two to three years, in India and Egypt from six to ten; where the climate is excessively hot, it is long-lived.

3. THE COTTON TREE (*Gossypium arboreum*).—The cotton trees inhabits India, China, Egypt, the coast of Africa, and some places in America. It grows from fifteen to twenty feet high, and its flowers are red. It yields a

variety of cotton of a very fine, soft, silky nature, used by the Hindoos for making turbans.

The cotton-plant is cultivated in fields, and treated as an annual. It is grown from seed which is placed in the ground in holes sufficiently wide apart to allow for the growth of the plant. The plants are carefully tended until they flower, which is usually eighty days from the time of sowing. The flowers, which are handsome, either yellow or red, are succeeded by capsules, which, when ripe, open, and the cotton-covered seeds in their interior are immediately removed by the cultivator before the wind is able to scatter them. These cotton seeds are then sent to a mill, where by means of a peculiar apparatus called a *gin*, the cotton is separated. They are then either kept for sowing again, or as material for the manufacture of oil and oil-cake for cattle.

Cotton comes to this country in compressed bales; the average weight of a bale varies from 560 lbs. of Mobile cotton, 450 lbs. of New Orleans, 380 lbs. of Indian, to 180 lbs. of Brazilian. A "bale" properly means a rectangular body with flat sides, and often consists of battens of wood tied with rope or iron hooping. Thus a bale of hops is flat sided or box-shaped, and a pocket of hops is a long sack and, therefore, round. The terms bags, bales, pockets, boxes, barrels, trunks, drums, and such-like commercial descriptives, are very arbitrary, and apply only to each special class of goods.

The spread of the English spinning and weaving machines, and the substitution of the power-loom for the hand-loom, has caused such an amount of prosperity to the cotton trade, that it is now one of the most important branches of our foreign commerce. Such is the keen competition among manufacturers and such the economy of machine working, that consumers can often obtain cotton cloths at barely more than the cost price of the fibre.

Foreign cotton is separated into the following varieties :—

*North American or United States Cotton.*—This is produced in the states of Georgia, South Carolina, Alabama, Mississippi, and Louisiana. The best American cotton, in fact the best known in the market, is the celebrated Sea-island which grows on a row of islands situated along the coast of Georgia. The principal ports for the exportation of United States cotton are Charleston, New Orleans, Mobile, and Savannah.

*South American Cotton.*—This comes into the market from the Brazils, Guayana, Columbia, Venezuela, New Granada, and Peru. Almost all the West India Islands produce cotton of a superior quality, preferable to the Brazilian.

*East Indian Cotton.*—Formerly very inferior to the North American, although British India, next to America, furnishes the largest quantity. The staple is very short, and less adapted to European machinery, which is framed for working the finer American long cotton. This cotton is raised chiefly for exportation to China. A better staple has been produced in India from American seed, and already a considerable quantity has been exported to England. East Indian cotton comes in packages, very strongly compressed and corded, once carried on the backs of camels, or on wagons, to the Ganges, and there received into boats with capacious interiors; these descend the river, and take the cargo to European ships. The East Indian sorts known in commerce are the Bengal, Madras, Bombay, Surat, Siam, and Manilla cottons. A government return requiring a map of India to be marked with the places of its cultivation, no room was left for any other marks on the map. The American War, 1860–5, gave a great impetus to the trade, which the network of railways, of recent construction, allowing of crops far from ports to be cheaply forwarded, has since maintained.

*Levant Cotton.*—This includes all the cotton which is received from ports in European and Asiatic Turkey, as well as from the Morea and the Archipelago. Like that from British India, it is of inferior quality. The principal sorts are the Smyrnian, Syrian, Cyprian, Macedonian, and Persian cottons. Most of the last is consumed in Persia, excepting some small quantities, which go to Russia, *viâ* Astracan.

*African Cotton.*—Excellent cotton is received from the French island of Bourbon; Egyptian cotton has also greatly improved in quality recently, because the crops have been raised from American seed. The best African cotton is, however, grown in Algeria, and is remarkable for the beauty of its colour, the fineness of its silk, the care taken in harvesting the crop, and the good condition in which it appears in the market. The long staple cotton of Algeria partakes at the same time of the character of the long staple of Georgia and the short cottons of Egypt, and approaches in quality the finest Louisiana variety. Algeria is capable of producing the finest cotton in the world.

The value of cotton in commerce depends on the length and strength of the fibre or staple. Cottons may be divided into the long staple and short staple. The United States generally furnish the short staples in the greatest quantity, with the exception of one sort, known as the Georgia or Sea-island cotton, of which the production elsewhere is very limited. Cotton threads are numbered from 1 to 300, according to the degree of fineness to which they are spun. In weaving, the cross threads or woof are shot by the machine across or at right angles to threads extending longitudinally, called the warp. Long staple cotton is generally spun into the threads for the warp, and the short staple is used for the woof.

The chief seats of the cotton manufacture in the United

Kingdom are Manchester, Bury, Oldham, and Glasgow. Most of the cotton-mills give employment to a large number of hands, presenting the most perfect order in every department. All these persons are employed by means of the fine white silky hairs which clothe the seed of the cotton-plant, in order to effect its dispersion, and which is manufactured into clothing for many millions of the human race.

JUTE, or GUNNY FIBRE, is the produce of *Corchorus capsularis*, L. (natural order, *Tiliaceæ*), an annual, growing from twelve to fourteen feet high.

The fibre contained in the bark is generally about eight feet in length, and is obtained by treatment very similar to that adopted with the flax and hemp plants. Jute fibre is fine, and has a remarkable satiny lustre, so that it is sometimes mixed with the silk in the fabrication of cheap satins, and is very difficult to detect. Its chief use is for making coarse canvas, or *gunny*. Rice, oil-seeds, dye-stuffs, cotton, and sugar, are all sent to us from India in gunny bags or bales. When wet, jute fibre quickly rots, so that it is not adapted for the manufacture of either sail-cloth or cordage; but notwithstanding this, it is often mixed with hemp for the latter.

NEW ZEALAND FLAX (*Phormium tenax*, Forst.; natural order, *Liliaceæ*).—A coarse growing bulb, with long narrow leaves, the slender fibres of which glisten like silk, and are white as snow. Its flowers are of a brownish-red colour.

This plant inhabits the marshes of New Zealand, but grows well in any soil; and in mild climates, such as the south of France, winters in the open air. It affords a fibre of great strength, stronger than hemp, which is extracted by maceration, drying, and heckling. Good ropes can be made from the coarser, and very fine linen from the finer fibres. No machinery has yet been contrived which

can approach or even imitate the dexterity of the native women in separating the fibre from the coarser parts. New Zealand flax fibre will not bear a cross strain, and, therefore, cannot be tied into a knot without breaking. Great hopes of the utilisation of this soft, silky, and tenacious fibre have not been fulfilled, and, as a commercial commodity, it has almost disappeared from the market.

Coir-fibre (*Cocos nucifera*, L.; natural order, *Palmaceæ*). —This fibre is obtained from the outer husk of the coconut. It is stronger than hemp, and more capable of withstanding the action of water. It is separated from the husk by beating, and then cleaned by heckling. Coir-fibre is spun by the natives of India and Ceylon into yarns of different length and thickness, which are largely exported to Europe. The yarn on reaching this country is manufactured into ropes, door-mats, and floor-mattings, which are cheaper but less durable than those made from bristles. In India, coir-fibre is very generally used for ship-cordage and fishing-nets.

Carludovica Palmata, L. and P. (natural order, *Pandaneæ*).—This species of screw pine bears fan-shaped leaves from six to fourteen feet long, and four feet in breadth. It ranges from 10° N. to 2° S. latitude on the American continent.

Panamá hats are distinguished from all others by consisting of a single piece, as well as by their durability and flexibility, and are so named because they are shipped through Panamá, though a large proportion are manufactured in Guayaquil, Ecuador. The finest hats are made in South America with fibre of the unexpanded leaf, called "torquilla," from which are also made very fine hammocks.

The leaves are gathered before they unfold, all the ribs and coarser veins removed, and the rest, without being separated from the base of the leaf, is reduced to shreds.

After having been exposed to the sun for a day, and tied into a knot, the straw is immersed into boiling water until it becomes white; it is then hung up in a shady place, and subsequently bleached for two or three days. The straw (*paja*), now ready for use, is sent to different places, where the Indians manufacture from it hats, hammocks, and those beautiful cigar-cases which cost as much as five and six pounds a-piece. The plaiting of the hat is done on a block, which is placed upon the knees; it is commenced at the crown and finished at the brim. According to the quality of the hats, more or less time is occupied in their completion; the coarser ones may be finished in two or three days, the finest take as many months.

These hats are also made in Veraguas, Western Panamá, Costa Rica, and New Granada. The petioles of the leaf are made into baskets, called *petacas*, the fibre being variously dyed.

MANILLA HEMP (*Musa textilis*, Tournef.; natural order, *Musaceæ*) produces a woody fibre, which is used in India in the manufacture of fine muslins, the most exquisite textile fabrics, and the elegant Manilla hats. The much prized white rope of Manilla hemp fibre is derived from the wild plantain of the Philippines.

CHINA GRASS (*Boehmeria nivea*).—Under this name is fabricated from the fibre of an Indian nettle, the *Rhœa* a beautiful fine cloth of the character of French cambric, and used for similar purposes.

As fibrous tissue, cellular or ligneous, is contained in every plant, its range is coincident with that of the vegetable kingdom. The demand for these fibres for cordage, yarns, and paper-making, keep enterprise alert to discover the best sources of supply. Exogens yield fibres chiefly from the barks and stems; endogens from the leaves. Exogenous fibres occur in cords or bundles, and often reticulate as in

the lace-bark. Some varieties of bark fibres receive the name of bast. Endogenous fibres run in parallel strains through the length of the leaf.

Cloth is universally made by the Indians of Oceania of the cottony fibres of the Paper Mulberry, which, when moistened, readily felt under a wooden mallet. Japanese paper, made of the same raw material, is of such stout texture as to serve for curtains, dresses, and for countless other purposes.

Amongst the endogens, the *Agave* or American aloe produces a fine white fibre. By softening the leaf in water, a bundle of threads may be forcibly drawn out, attached to the spine at the ends of the leaf—fancifully called Adam's Needle and Thread. The common pine-apple possesses a soft, tenacious fibre, as suitable as flax for the finest textures.

The chemistry of the textile fibres promises to reward research with commercial results rivalling the recent grand discoveries connected with coal. Whatever the source of fibre, its ultimate and normal structure is cellulose. Cotton is the only fibre of pure cellulose. Other fibres are encrusted with hardened substances to more than fifty per cent. of their mass, some of which remains to give a distinctive character to the yarn, but most of it is wasted in retting and bleaching. The annual waste in these vast industries is serious both in a scientific and a commercial point of view.

Ekhman's patent process for separating from their incrustations fibres of every kind, whether for yarns or paper, claims to reduce them to pure cellulose, so that they can all be worked like cotton, or to halt at any stage in the reduction, and retain such portion of adherent matters as may be of service in special purposes. Further, it claims to leave an innocuous refuse, consisting of dextrine, glucose, vegetable acids,

volatile oils, and many economic constituents, to the scientific manufacturer, who may utilise this waste in bye-products of much industrial value. Ekhman's method of producing cellulose has stimulated the search for fibres, and incited to further improvements. Its most extensive application is in paper-making from saw-dust; now indispensable. The first cost of the raw material renders many fibres too dear, although destined for the paper-vat eventually in the form of rags. Short fibres, unsuited for weaving, are utilised. Cellulose from saw-dust, is prepared indistinguishable from the cellulose of other vegetable fibres, at a cost of production rather over £4 a ton, compared with £7 for that produced from straw, and more than £15 for that produced from Esparto grass.

## II.—Oleaginous Plants, or Plants yielding valuable Oils.

Oil is of the greatest importance in the arts. It is extensively used for burning in lamps, for diminishing friction in machinery, for making candles and soaps, in the manufacture of paints and varnishes, and in wool-dressing—five gallons of olive, rapeseed, or other oils, being used in the preparation of every pack of wool—also as an article of food, and as medicine. Oils are distinguished into two kinds: fixed or fat oils—which are obtained by pressure from the fruits or seeds of plants—and essential oils. The fixed oils burn with a clear white light, and boil at a high temperature, about 600° F.; most are liquid at the ordinary temperature; but coco-nut and palm oils are solid at 50° or 60° F. All the fixed oils are nearly inodorous, and lighter than water. The volatile, or essential oils, give off vapour at the temperature of boiling water, when mixed with water, or under 320° F. by themselves.

### *A. Fixed Oils.*

PALM OIL is principally produced from the fruit of *Elais Guineensis*, L., a native of the western coast of Africa. The fruit is about the size of an olive, of a yellow colour, three-fourths of which consist of a yellow oily pulp. The oil is yielded by the pericarp, fleshy cover, or husk, and penetrates the hard external shell. By boiling, the oil floats on the surface of the water and is skimmed off and casked. The kernel gives *palm kernel* or *palm nut oil*, which closely resembles cocoa-nut oil. These kernels or seeds are imported less for their oil, than for making a rich cattle cake.

Palm oil yields palmitic acid, having a melting point of about 145° Fahr. and fit, chemically, for making hard candles. Palm oil is used in England principally in the manufacture of yellow soap, but with the Africans it is an article of food. A generation ago large tracts of country along the western coast of Africa were covered by the oil palm, then little cared for; now a large foreign demand for palm oil has sprung up, and with it property in these trees. This oil trade has become more valuable than the slave trade which once flourished on the Gold Coast and at the mouth of the Niger. Industry and a desire of accumulating property are at last manifest amongst the African population, and everywhere are now to be seen on this coast the germs of a hopeful civilisation.

COCOA-NUT OIL, obtained from the albumen of the kernels of the cocoa-nut (*Cocos nucifera*, L.), is principally used for making cocoa-stearine for candles. In Trinidad and Demerara it is used by the coolie labourers as we employ butter. Cocoa-nut oil yields *cocinic acid*, with a melting point under 100° Fahr. Composite candles get their name from being composed of blended proportions of palmitic and cocinic acids, with a medium melting point. The low

melting point of cocoa-nut oils renders them undesirable for candle making, while the hard palmitic acid has a strong tendency for guttering. Both of these disadvantages are remedied by making *composite* candles.

Cocoa-nut oils are generally dearer than palm oils, since they are derived from trees grown under special cultivation, while palm oils come from self-cultivated trees.

CASTOR OIL PLANT.—(*Ricinus communis*, L.; natural order, *Euphorbiaceæ*). This plant, in temperate climates, is a large herbaceous annual, with monœcious flowers, the lower male, the upper female. The capsules are prickly, three-celled, with one seed in each cell. The seeds are of a grey colour, marbled with black.

The castor oil plant is a native of India, Africa, and the West Indies. In warm climates it acquires a woody stem, and becomes a tree, rising in India often to a height of thirty feet. Nevertheless it is still the same plant, and not entitled to be considered as a distinct species, although perennial; the leaves and flowers are unaltered, and the seed, if sown in temperate climates, produces herbaceous plants in every respect the same as those in common cultivation.

Castor oil is obtained by expression from the seeds without heat, hence it is called "cold-drawn castor oil." The seeds, deprived of their cuticle and sewn in horsehair bags, are crushed by the action of heavy iron beaters, and the oil, as it oozes out, is caught in troughs and conveyed to receivers, whence it is bottled for use. An inferior oil is expressed from the cake by the application of heat. Castor oil is brought over from the East Indies in small tin cases closely soldered and packed in boxes, weighing about two cwts. each. Castor oil is much used in medicine as a mild and certain purgative. An oil obtained from the cuticle is as violent in its effects as croton oil. Castor oil is also employed in our manufactures.

OLIVE OIL (*Olea Europæa*, L.; natural order, *Oleaceæ.*)—"Minerva's tree." This, according to Columella, "chief of all trees," is a small evergreen, much branched, and covered with a greyish bark. The olive itself is a drupe or stone fruit, with a fleshy covering about the size, shape, and colour of a damson. When ripe this fleshy covering contains an abundance of olive oil, which it yields by expression.

The olive is indigenous to Palestine, Greece, and the slopes of the Atlas mountains in Africa. It is now widely diffused in Europe, and is cultivated with great success in Italy, Spain, the South of France, Naples, Sicily, Southern Illyria, Lombardy, and Dalmatia.

The olives are gathered when nearly ripe, and the oil is drawn from them by presses and mills, care being taken to set the mill-stones so wide apart that they will not crush the stone of the fruit. The pulp is then subjected to a gentle pressure in bags made of rushes, and the best or *virgin* oil flows first. A second oil, of inferior quality, but fit for table use, is obtained by moistening with water the residuum, breaking the stones, and increasing the pressure; lastly, more water is added and the residuum is again re-pressed, the product being an impure oil, fit only for soap-making or for burning. Spanish or Castile soap is made by mixing olive oil and soda; and soft soap, by mixing fat, or fixed oil, with potash. The *marc* of olives, as the residuum is called after the oil has been expressed, is valuable either as a manure or as food for cattle.

The virgin oil is called Florence oil, and is imported in flasks surrounded by a network formed of rushes to protect the glass, which, too fragile for a cork, is stoppered with cotton wool, bound over with skin. The finest brands of Provence, Genoa, and Lucca are securely sealed in superior bottles. The difference of quality in the produce is extreme, but due, almost solely, to the greater or less care

in preparation. It is used at table under the name of salad oil. Gallipoli oil forms the largest portion of the olive oil brought to England and is imported in casks. Olive oil is largely used in this country in dressing woollen goods, and for machinery.

The olive lives to a great age. Its timber is close-grained, of hard texture, bears a high polish, and is in universal industrial request.

RAPESEED, the seed of *Brassica napus*, L.; natural order, *Cruciferæ*.—This plant grows wild in many parts of England, and is cultivated in this country, in France, and in Germany, for the sake of the oil procured from its seeds. Rape oil is more suitable than any other oil for the lubrication of machinery, and is now much used for locomotives, marine engines, and for burning in lamps. A single locomotive consumes from 90 to 100 gallons of oil annually. The consumption of oil by the London and North-Western Railway Company alone is immense. Good English rapeseed yields an oil very superior to that obtained from foreign rape; nevertheless, we import an enormous number of quarters of rapeseed and hundreds of tons of the oil, chiefly from France and Germany.

LINSEED, the seed of *Linum usitatissimum*, L.; natural order, *Linaceæ*.—We have already described this plant under the name of flax. Flax seed or linseed yields a most valuable oil known as linseed oil, largely employed in the arts, especially in painting and in the manufacture of printer's ink. It becomes solid on exposure to the action of the air, or in other words, is one of the drying oils. This article is always imported in the form of seed. Its economic value is proved by imports, exceeding annually a million quarters, principally from the East Indies and Russia. Smaller quantities arrive from Prussia, Germany, Egypt, and America.

SESAME (*Sesamum orientale*, L.; natural order, *Pedaliaceæ*).—This is a small showy annual, indigenous to India, and

to the whole of Southern Asia, from Japan and China to the shores of the Mediterranean. In these countries it is much cultivated, and the oil yielded in abundance by the seed, is used for dressing food, and as a common lamp-oil. In the East this oil has some considerable repute as a softener and beautifier of the skin, and as an application to scorbutic eruptions.

Sesame oil is without odour, and does not easily become rancid. It is frequently used for the adulteration of balsams and volatile oils. Large quantities of the seed are brought to this country from the East Indies and Egypt.

There are several other oil-producing plants in the market, but not much in demand. The following are deserving of notice :—Croton Oil (*Croton tiglium*, Lam.) This oil is a valuable and most powerful purgative, capable in over-doses of destroying life, and only administered one drop at a time, in cases where it is of the utmost importance to make a speedy impression on the bowels, and where the patient has difficulty in swallowing. It is also valuable as a counter-irritant. Croton oil is obtained by expression from the seeds. The common hazel nut (*Corylus Avellana*, L.) yields an oil most valuable for the delicate machinery of watches, diminishing the friction of the pinions, the axles of the wheels, and other rapidly moving parts, which would otherwise wear injuriously, and speedily become disordered. The oil of almonds also is employed for the same purpose. Other oils, obtained from the ground nut, carthamus seed, and various oleaginous nuts and seeds, are imported every year for the British crushing mills to the extent, in the gross, of several hundred thousands of tons.

### *B. Volatile or Essential Oils.*

These oils occur in the stems, leaves, flowers, and fruits of most sweet-scented plants, whence they are obtained by

distillation. In this respect they differ from the oils already described, which are found only in the seed, obtained by expression from the same, and do not evaporate. The difference between fixed and volatile oils is easily shown. A drop of any fixed oil—such as olive oil, for instance—leaves a stain on paper which is permanent; but a drop of any volatile or essential oil—as for example, oil of bergamot—makes a similar stain, which evaporates and disappears.

To obtain essential oils the leaves, flowers, or other parts of the plant are put into an apparatus for distillation. This always consists of a boiler in which the vapour is raised, and a condenser in which it again becomes fluid. For distillation on a small scale, a common retort and receiver answer every purpose, care being taken to keep the receiver cool, by placing it in cold water. When the water boils, the steam passes through the retort into the condenser, where it is re-converted into water, the essential oil floating on its surface; this is skimmed off, and afterwards purified by filtering. The perfume of flowers depends on the presence of a fragrant volatile or essential oil, peculiar to the plant. When we obtain this oil, we really get the essence of the plant, or the essential principle which makes it valuable. Although the plant may be an annual, and perish together with its fragrance in a few weeks or months, yet, if we extract the oil, we retain the essence of the plant. The following are the most important of the essential oils which occur in commerce:—

OIL OF LAVENDER, from *Lavandula spicata*, *L. vera*; natural order, *Labiatæ*.—Large quantities are raised at Mitcham, in Surrey; but it is also imported from France and Germany. English oil of lavender is acknowledged to be much superior to any produced in warmer climates.

OIL OF THYME, from *Thymus vulgaris*, L.; natural order,

*Labiatæ.*—This oil is distilled from all parts of the plant, It comes into this country from Hamburg and from the United States. Used in scenting Windsor soap, also in flavouring dishes, in confectionery, and in medicine.

Oil of Peppermint, from *Mentha piperita*, L.; natural order, *Labiatæ.*—Besides that raised and manufactured at home, we receive large quantities from Germany and the United States, for use in cordials, confectionery, and medicine.

Oil of Anise, from *Pimpinella anisum*, L.; natural order, *Umbelliferæ.*—This plant is a native of the Levant, whence a great deal of the anise of commerce is derived. It is much cultivated in France, Naples, and Germany—particularly in Thuringia and Swabia. We receive considerable importations from Germany and the East Indies; but those sorts coming from Spain, Apulia, and Malta, are the most valuable.

Oil of Caraway, from *Carum carui*, L.; natural order, *Umbelliferæ.*—The best caraway oil comes from Malta, Naples, and Alicante in Spain. Small quantities are received from Germany. Much more, however, is home-manufactured and exported.

Cinnamon, clove, cassia, pimento—all yield essential oils, to which reference has already been made; oil of bergamot, oil of lemons, and Neroli oil, or oil of orange flowers, have also been mentioned in connection with those fruits.

Oil of Roses, Attar of Roses, or Otto of Roses, is distilled from the petals of *Rosa centifolia*, L., *Rosa gallica*, L., and numerous other species of rose. The attar of roses is prepared in Persia and other Asiatic countries; but, with all the aids of science, the process still remains unknown to Europeans. Some idea of its costliness may be gathered from the fact that 100,000 roses must be distilled to yield

180 grains, or three drachms of pure attar. Five guineas have often been paid for one ounce of this essence. It is the favourite perfume of the whole civilised world, and in Oriental countries is a most essential luxury. In Cashmere the harvest of rose leaves is celebrated as the festival of the year, and is exquisitely described in the verse of Moore.

## III.—Tinctorial Plants, or Plants furnishing valuable Dyes.

The clothing furnished by the textile plants and the sheep's wool, would be of one dull uniform hue, if it were not for the valuable dyes furnished by tinctorial substances or dye-stuffs. At first the colours of plants, when transferred to clothing, imparted only a temporary beauty; for the art of fixing them, or uniting them permanently with the cloth, by means of mordants, was unknown. By experiments long and carefully conducted, we are able to render these colours fast, or permanent, thus enriching our silken, woollen, linen, and cotton manufactures with an almost endless variety of beautifully coloured designs. It is impossible to mention even the names of the numerous plants which furnish materials for the dyer. Only a few, and those the most common in the commercial world, can be noticed. All the parts of plants furnish these dyes; sometimes the root, or the wood of the stem, sometimes the leaves, flower, or fruit.

Alkanet Root (*Anchusa tinctoria*, L.; natural order, *Boraginaceæ*).—A perennial herbaceous plant with a stem about a foot in height, purplish flowers, and a long woody root, with a deep red bark. It is a native of the Levant, and is much cultivated in Germany and the south of France, particularly about Montpellier, for the sake of the red

colouring matter easily obtained by soaking the root in alcohol or oil. It is used for colouring ointments red, especially lip salves; also as a dye, to colour gun-stocks and furniture in imitation of rosewood. Alkanet root comes to this country in packages, weighing about 2 cwts. each, chiefly from Germany and France.

SUMACH (*Rhus Coriaria*, L.; natural order, *Anacardiaceæ*).—The sumach of commerce is the crushed or ground leaves and flowering or fruiting tops of this plant, imported from Sicily. This material is valuable for tanning light-coloured leather, and imparts a beautiful bright-coloured yellow dye to cottons, which is rendered permanent by proper mordants.

ARNOTTO OR ANNOTTO (*Bixa orellana*, L.; natural order, *Flacourtiaceæ*).—This is a small evergreen tree, indigenous to tropical America, and cultivated in the East Indies. It is called *Roucon* by the French, and the Orleans tree by the Germans. The first South American settlers noticed the brilliant and showy colour obtained from its berries, on the bodies of the Indians, by whom it is called "Bixa," or "Bija," and not only used it themselves, but speedily converted it into an article of commerce. The arnotto tree grows about twelve feet in height; its leaves are smooth and heart-shaped, and its pink-coloured flowers are followed by oblong bristled pods, somewhat resembling those of the chestnut, at first rose-coloured, but changing as they ripen to dark brown. On bursting open, these pods show in their interior a splendid crimson farina or pulp, in which are contained ten or twelve seeds, in colour somewhat resembling coral beads. The arnotto of commerce is prepared from this crimson pulp. By maceration in hot water the seeds are separated from the pulp, which is then made into balls or cakes of two or three pounds' weight; these, when dry, are wrapped up in large leaves and packed in casks for

exportation. Another kind—the roll arnotto—is of a much superior quality. It is a hard extract, and contains a much greater proportion of colouring matter.

Good arnotto is of the colour of fire, bright within, soft to the touch, and dissolves entirely in water. It is used in Holland for colouring butter, and in Cheshire and Gloucestershire for dyeing cheese (under the name of cheese-colouring), to which it gives the required tinge, without imparting any unpleasant flavour or unwholesome quality. Flag or cake arnotto comes from the West Indies, especially from the island of St. Domingo or Hayti. Roll arnotto is principally brought from the Brazils. The rolls are small, not exceeding two or three ounces in weight. Arnotto is also used to dye silks and cottons, especially to form the colour called aurora. It is much to be regretted that the beautiful orange and gold-coloured dyes yielded by this plant are fugitive, and become discoloured in the sun. The bark o the arnotto tree makes good ropes, available in the West Indies for common plantation uses.

Myrobalans (*Terminalia chebula*, L.; natural order, *Combretaceæ*).—This dye is obtained from a small tree indigenous to British India, and closely allied to the myrtle. All the species of *Terminalia* have astringent properties. The fruit and galls of this tree are very astringent, and much valued both by dyers and tanners. The fruit is about the size of a date, pointed at the ends, and of a yellowish brown. The myrobalans of commerce are probably derived from more than one species. With alum they give a durable yellow colour. Myrobalans are now an important item in our commerce. We receive them from Calcutta, Madras, and Bombay.

Safflower (*Carthamus tinctorius*, L.; natural order, *Compositæ*).—Furnishes a beautiful rose-colour, which is used for silks, cottons, and the manufacture of rouge. Safflower is

an annual herbaceous plant, somewhat resembling a thistle, to which it is allied.

The safflower, a native of the Levant and the East Indies, is cultivated in China, India, and in the south of Europe. The dye is obtained from the florets, which are gathered, pressed into little cakes, dried, and packed in strong bales, weighing about two cwts. each. As found in commerce, these cakes consist of flaky masses of a red colour, intermixed with yellow filaments, the former tint being due to the corolla, and the latter to the stamens. The flowers thus contain two colouring principles, one yellow, soluble in water, and the other rose-red, called carthamine, or carthamic acid, soluble in alkaline solutions. This latter, when precipitated, dried, and mixed with finely-powdered talc, constitutes rouge. It is the carthamic acid which renders the safflower valuable as a dye, the use of which was introduced into Europe by the Arabs. Safflower seeds are eaten in Egypt and are substituted for rennet in Italy for curdling milk.

The greater portion of the safflower imported into this country comes from Persia, Egypt, and the East Indies.

LOGWOOD (*Hæmatoxylon Campeachianum*, L.; natural order, *Leguminosæ*).—A middle-sized tree with a contorted trunk, rarely more than one foot and a half in diameter, covered with ash-coloured bark; branches crooked, beset with sharp thorns.

This tree, indigenous to Central America, Mexico, and Campeachy, has been introduced into the West Indies, and is now naturalised there. The heart-wood is the part of the tree employed; the generic name refers to its blood-red colour. Logwood is of frequent use in the arts, as it forms the basis of many of the reds in printing calicoes, and is esteemed one of the best deep red dyes. It is imported in logs, which are cut up into chips and ground to powder

for the use of dyers, hatters, and printers, in powerful mills constructed for that purpose. Logwood, when boiled, communicates its own dark red colour to the water, and the addition of a few drops of acetic acid changes the colour to a bright red. Red ink is made in this way, a little alum being added to render the colour permanent. If an alkali such as soda or potash be added, the colour changes to a dark blue or purple, and with a little management every shade of these colours may be obtained. Logwood is so hard and heavy as to sink in water. It is used chiefly for dyeing red, blue, and black. We import every year large quantities from South America, whence a great deal also goes to Spain, France, and Germany. The principal ports for the reception of logwood are London, Cadiz, Bordeaux, and Hamburg.

MADDER (*Rubia tinctoria*, L.; natural order, *Rubiaceæ*). Madder is cultivated in the Netherlands, France, Southern Europe, and the Levant, where it is indigenous, for the sake of the valuable red dye furnished by the root. The roots are dug up when the plant is about three years old, carefully dried, and packed into bags or bales for exportation. As found in commerce, madder-root is in long cylindrical pieces, about the thickness of a quill, and of a deep red or brown colour. If ground before exportation, the powder is sent in very large casks. We get madder roots whole from India, Turkey, Greece, Spain, and France; and ground from Holland and Germany. Powdered madder root is a bright Turkey red, but by the addition of suitable chemicals every shade of red, purplish-brown, purple, lilac, and even a lively rose colour can be obtained from it. Madder root imparts its red colour to water and alcohol. It is used as a basis for red dyes, as it affords a tint which, when properly fixed by appropriate mordants, is not affected by light or moisture. Scarcely a calico or muslin print was

made without the aid of madder root, in some way or other, for forming the pattern. A dye-stuff, under the name of *Garance* or *Garancine* is extracted from the powdered madder root. Aniline dyes from coal have caused the cultivation of madder nearly to disappear.

INDIGO (*Indigofera tinctoria*, L.; natural order, *Leguminosæ*).—A shrub from two to three feet high, with pinnate leaves, and racemes of greenish-coloured flowers, marked with vermilion red. Indigo is also extracted from two other species, viz., *Indigofera anil* and *I. cærulea.*

This plant is a native of India, whence the chief supplies of indigo are received. It is principally grown in Bengal, from the 20° to the 30° N. latitude. Indigo is also cultivated in Java, the Philippine Islands, Egypt, the West Indies, and British Honduras.

The best time for cutting the plant is when it begins to flower, because then it is always richest in its peculiar secretions. The plants, when cut, are first laid in a vat, called the steeper, about twelve or fourteen feet long and four feet deep, and filled with water. In twelve or sixteen hours the water begins to ferment, swell, and grow warm; the highest point of its ascent is marked, for when it ceases to swell, fermentation begins to abate. During the process a change of colour in the juice takes place from greenish to that of true indigo blue. The manager now opens a tap to let off the water into a second vat, called the beater, and the gross sediment at the bottom of the first one is carried off and used as manure for the next crop of plants, for which purpose it is excellent. The indigo fluid received into the second vat is kept actively stirred and beaten with bamboos until it begins to granulate. When granulated sufficiently, the liquor assumes a deep purple colour, the whole being troubled and muddy. It is now allowed to settle, and as the upper part of the water clears,

it is removed into other vessels, until nothing remains but a thick sediment at the bottom of the vat. This is put into gunny bags, which are hung up to drain and dry. To finish the drying, the indigo is turned out of the bags, exposed to the sun, worked upon boards with a spatula, cut into cubes, put into boxes, and again exposed to the sun until fully dried, when it is ready for market.

The indigo plant grows best in the East Indies. It was first brought to Europe by the Dutch in the middle of the seventeenth century. It is now imported, every year in increasing quantities, from the East Indies, and also from both North and South America, to which it has been transplanted. Indigo is used in the dyeing-houses of our woollen, linen, cotton, and silk manufacturers, and has almost completely displaced the native woad (*Isatis tinctoria*, L.), whose colour is less lively though more durable. The finest sort comes from Bengal, *viâ* Calcutta, and British India has almost a monopoly of the indigo trade. The French import a very good quality from the Isle of Bourbon, and the Dutch from the Sunda Islands, in the East Indies. The best American indigo is raised in Guatemala, in Central America, and an inferior kind at Caracas, in Brazil, St. Domingo, Carolina, and Louisiana. There are indigo plantations on the fertile delta of the Nile, under the management of Hindoos. Indigo has also been received recently from Madeira, the river Senegal, and Sierra Leone.

Good indigo is known by the purity of its colour and its lightness, which is indicative of the absence of any earthy impurity. A blue carmine, made out of this substance, is a very high-priced colour, used by painters. The value of indigo consists in its power to impart to every kind of fibre a permanent colour, without a mordant.

TURMERIC (*Curcuma longa*, L.; natural order, *Zingiberaceæ*).—This is a stemless plant, with tuberous rhizomes

of a deep orange colour internally, and flowers in a central oblong green spike.

Turmeric is a native of the warm parts of Asia, and is found in India, China, Cochin-China, Java, and Malacca, where it is cultivated for the sake of the beautiful yellow dye afforded by its root, and also as a condiment, as it forms a principal ingredient in Indian curry powder. Turmeric gives a beautiful but fugitive gold colour to silks. Paper stained with turmeric is much used by chemists as a test for alkalies, which colour turmeric paper reddish or brownish. Turmeric is also used in making Dutch pink and gold-coloured varnish. There are several varieties of this dye in the market, the principal of which are the Long Turmeric and the Round, better known as Chinese Turmeric. The dye consists simply of the rhizomes, either whole or reduced to powder. The rhizomes are much like ginger in shape and size, and have been successfully propagated in the West Indian Islands.

QUERCITRON (*Quercus tinctoria*, Michx.; natural order, *Cupuliferæ*).—This oak grows from sixty to ninety feet high. Its leaves are six to eight inches long, the acorn small ovoid, seated in a sub-sessile cup, which tapers at the base.

The tree is indigenous to the United States, growing abundantly in Pennsylvania, North and South Carolina, and Georgia. The inner bark is an article of commerce under the name of Quercitron, and furnishes a yellow dye, which has now superseded the use of our indigenous Weld (Dyer's Weed) in calico printing. Quercitron, when crushed, resembles a mass of short yellowish-white fibres, mixed with powdery particles, and in this state is sent over in casks. The bark is employed in the United States for tanning; its colour being chemically neutralised.

YELLOW BERRIES (*Rhamnus infectorius*, L.; natural order, *Rhamnaceæ*).—This plant is a species of buckthorn, and is

a native of Persia, Turkey, and the south of Europe. It is a procumbent shrub, growing naturally in rough, rocky places. The unripe berries furnish a yellow dye, which is largely employed in calico printing, for dyeing morocco leather and paper, as well as for the preparation of sap green and Dutch pink. The largest and best yellow berries are the Persian, which come to this country *viâ* Aleppo and Smyrna; a considerable quantity is also received from France and Turkey.

FUSTIC (*Maclura tinctoria*, Nutt; natural order, *Urticaceæ*). A large and handsome evergreen tree, a species of mulberry, growing in the West Indies and tropical America. There are large forests of this tree in the Antilles, especially in Jamaica, Cuba, Porto Rico, and Tobago. Fustic is brought to market in long pieces or logs. The beautiful yellow and red veined is the best. Fustic dyes yellow, olive, brown, maroon, bronze, and Saxon green. But the extract does not contain more than a fourth of the colouring matter of quercitron.

WOAD (*Isatis tinctoria;* natural order, *Cruciferæ*).—Woad is cultivated in France, Normandy, Alsace, and also in Germany, where it was in use a thousand years ago. It is indigenous to England and Germany. The blue matter of this plant is contained in its leaves. Woad was used by the ancient Britons to stain their bodies. The extensive use of East Indian indigo has greatly restricted the cultivation of woad, but the dyers unwillingly dispense with it, on account of its cheapness, and the durability of its colour. Nevertheless, the elaboration of artificial indigo, one of the latest triumphs of chemistry, threatens, by its simplicity and economy, to diminish the culture both of indigo and woad.

NICARAGUA OR PEACH WOOD (*Cæsalpinia echinata;* natural order, *Leguminosæ*).—This dye wood gets its name from

the republic of Nicaragua in Central America. It reaches this country in blocks about four feet in length and eight inches in diameter. It dyes a delicate peach and cherry colour, and is much used. That which comes from Peru yields the finest shades of colour.

Several other species of *Cæsalpinia* yield dye woods. Thus *Cæsalpinia crista* furnishes the Brazil wood, and *Cæsalpinia Brasiliensis* the Brazilletto wood, which gives fine rose-coloured, yellow, and orange-red dyes, according to the mordants used. Both annually arrive in England from the forests of South America, which are rich in dye woods. Brazil wood is imported from Pernambuco, and is also known by the name of Fernambuk wood, in allusion to the place of exportation. Besides its usefulness as a dye wood, it serves for objects of art; bows of violins are especially made from Fernambuk wood.

SAPAN WOOD or BUKKUM WOOD (*Cæsalpinia Sapan*) furnishes another red dye, which is used both in India and Europe.

RED SANDERS WOOD (*Pterocarpus santalinus*, L.; natural order, *Leguminosæ*) yields a dye of a bright garnet red and is employed for dyeing wool. The tree which produces the wood is lofty, common about Madras and other parts of India.

ORCHELLA WEEDS (*Roccella tinctoria*, *R. fuciformis*, and *R. hypomecha*, L.; natural order, *Lichenes*).—These lichens, which constitute the orchils of commerce, are of an ash-grey colour, having a thallus much branched, flattened, and mealy in appearance, from one inch and a half to two inches in length. The blue dye known under the name of archil or orchil is prepared from these plants, which grow on all the rocky coasts and islands of the Mediterranean, and also in the Canary Islands, Madagascar, Cape of Good Hope, and South America. The colour yielded is not in itself fast

but so greatly improves others that orchil is regarded as indispensable by the dyers. An inferior orchil is found on the rocks of Guernsey and in the Isle of Portland.

THE TARTAR LICHEN (*Lecanora tartarea*, L.), indigenous to Sweden, Norway, and England, answers the same purpose. Litmus paper, used by chemists as a test for acids and alkalies, is prepared from the blue dye furnished by this lichen. Whole cargoes are annually brought from Sweden to Holland, where its dye, called cudbear, is skilfully prepared, and called Dutch blue.

## IV. PLANTS FURNISHING VALUABLE BUILDING AND FURNITURE WOODS.

### *Timber.*

The cultivation of wood is carried on in several countries in Europe, where the population is considerable and the natural forests have disappeared; above all, Germany is to be distinguished for forest culture. But most wood, especially for ship-building, is procured from those countries where the natural forests remain—viz., from Russia, Norway, Sweden, Canada, and the United States. In Germany, vast quantities of wood are annually floated down the rivers Rhine, Maine, Neckar, Weser, and Elbe, from the productive woods of Thuringia, the Hartz, Fichtel, and Erz mountains, and the Black Forest. Russia exports wood considerably to England and the south of Europe, from St. Petersburg, Riga, Memel, Archangel, and ports in the Gulfs of Bothnia and Finland, and from the port of Odessa, on the Black Sea. Much timber is exported from Drontheim, Bergen, Drammen, and Christiana, on the coast of Norway; from Göttenberg, and all seaports in Sweden; and from Dantzic, Königsberg, and Stettin, Prussian seaports on the Baltic. American timber is exported to the United

Kingdom chiefly from Canada, New Brunswick, Pensacola, and adjacent ports in the Gulf of Mexico. The trade of England in pine and fir alone amounts yearly to over a hundred million loads.

MAHOGANY (*Swietenia mahogoni*, L.; natural order, *Cedrelaceæ*) occupies the highest rank amongst the furniture woods. This is one of the loftiest and most gigantic trees of the tropics; indigenous to the West Indies and Central America. The mahogany tree is cut down in April and May, which is the height of the dry season; it is then squared by the adze, the branches being lopped off; and about the middle of June, when the rivers are swollen by the rains, the logs are placed on trucks and drawn by bullocks to the water-side; there they are launched into the river, formed into rafts, and so floated down the stream to the vessels awaiting their arrival.

Spanish mahogany is imported from Cuba, St. Domingo, and the Spanish Main, in logs twenty-six inches square and ten feet long. Honduras mahogany, lighter than the Spanish, is imported in logs four feet square and eighteen feet long. Mahogany is chiefly valued for its colour, firmness, and durability, and the beautiful polish which it is capable of receiving. On account of these and other excellent qualities, it is particularly suitable for ships' fittings. Mahogany is light and buoyant, free from dry rot, and does not warp; it also suffers less from the action of shot than any other wood; since shot, when received by it, generally remains fast in the wood without splitting it.

Mahogany is used in the manufacture of the best articles of domestic furniture, fancy and ornamental wood-work, cabinet-making and veneering; in fact there are, comparatively speaking, but few persons who have not this wood in some form or other of useful home furniture.

EBONY (*Diospyros ebenus*, L.; natural order, *Ebenaceæ*).—

This tree is a native of the Mauritius. As soon as felled the timber is immersed in water from six to eighteen months; it is then taken out, and the two ends are secured from splitting by iron rings and wedges. Mauritius ebony is imported in round sticks, like scaffold poles, about fourteen inches in diameter. It is much used for inlaying and turnery.

A great deal of ebony comes from the Cape of Good Hope, and arrives in England in sticks of about three to six feet long, and two to four inches thick.

East Indian Ebony (*Dalbergia latifolia*, L.; natural order. *Leguminosæ*).—The real raven black ebony, one of the heaviest and hardest of all woods, and which in the fineness of its texture resembles ivory, is derived from this tree, which is indigenous to the island of Ceylon, and is also found in Java, Sumatra, and the Philippine Islands. This ebony is used for wind instruments and the keys of pianos.

The alburnum, or sap-wood of both the mahogany and ebony trees is white and valueless, and is chipped off with the adze before the logs are shipped. The indurated heart-wood of these trees is the only part of the stem fit for industrial and economic purposes.

Boxwood (*Buxus sempervirens*, L.; natural order, *Euphorbiaceæ*).—This is an evergreen shrub, a native of Southern and Western Europe. The wood is dense, compact, and admirably suited for wood engravers and also for the formation of graduated scales and fine works of art. It is imported in pieces four feet long and ten inches in diameter, from Smyrna, Constantinople, and the Greek Islands. The fine saw-dust of this wood is sold at Nuremberg and other places as pounce, which dries writing quickly.

Sandal Wood (*Santalum album*, L.; natural order, *Santalaceæ*).—This tree, producing the beautiful and per-

fumed sandal-wood, is a native of India and China. Sandal-wood is used for entomological cabinets, as its fragrance is a preservative from insects. In China it is employed as incense, and is manufactured into toys. The shavings and saw-dust of sandal wood are valuable in perfumery.

LIGNUM VITÆ (*Guiacum officinale*, Plum.; natural order, *Zygophyllaceæ*).—This is the hardest and heaviest wood known. It is of a dark olive colour, and cross-grained, the fibres running obliquely into one another, in a form somewhat resembling the letter X, so that it cannot be split with an axe, and is therefore divided by the saw. The tree is forty feet high, and four or five feet in circumference, with numerous knotted, much-divided branches, and bright blue flowers. It grows in tropical America, also in Jamaica, whence our supplies are chiefly obtained. The timber of this tree is very valuable, where strength and durability are needed and weight is no object. Lignum vitæ comes over in billets about three feet in length and a foot in diameter, and is chiefly used for ship-blocks and pulleys. It takes a fine polish, and turns well, and for this reason is used by turners for articles requiring a hard close-grained wood.

BIRD'S-EYE MAPLE (*Acer saccharinum*, L.; natural order, *Aceraceæ*).—This tree is a native of North America, where it grows from Canada to Georgia. In early spring it yields, when tapped, an immense quantity of sugar. The beautiful wood known as bird's-eye maple, so much admired in cabinet work, is obtained from this species.

AMERICAN CEDAR (*Cedrela odorata*, L.; natural order, *Cedrelaceæ*), a native of the West Indies and Central America. This tree furnishes the wood used for the boxes in which cigars are packed, and for the inside portions of furniture.

PENCIL CEDAR (*Juniperus Bermudiana;* natural order, *Coniferæ*).—A North American tree, which furnishes the red wood for lead pencils.

LANCE WOOD (*Duguetia Quitarensis*, St. Hilary; natural order, *Anonaceæ*).—Lance wood is used by coachmakers for the shafts of gigs and other vehicles where both strength and elasticity are required. We receive lance wood from Cuba and Guiana, whence it comes in the form of poles fifteen to twenty feet in length and six to seven inches in diameter.

ROSEWOOD (*Triptolemæa* and *Dalbergia;* natural order, *Leguminosæ*).—Several undetermined species of these genera of trees furnish rosewood. We receive this wood from Brazil, in planks about twelve feet in length, flat on one side and rounded on the other, each being evidently one half of the stem, with the bark removed. Violet wood and king wood, which come to this country also from the Brazilian forests, are probably only other species of the same plant, as both resemble the rosewoods. They are in much smaller pieces, usually in round sticks four or five feet long and from two to six inches in diameter. The best rosewood comes from Rio de Janeiro, and has recently been ascertained to be chiefly the timber of *Dalbergia nigra.* Rosewood is much used for library and drawing-room furniture, and is so named because, when fresh, it has the odour of a rose.

BLACK WALNUT (*Juglans nigra*, L.; natural order, *Juglandaceæ*).—This is a large tree, indigenous to North America. Previous to the introduction of mahogany and rosewood, walnut was held in estimation in the manufacture of costly furniture; it is imported for this purpose, though to a less extent than formerly, and is employed in the manufacture of the stocks of all kinds of fire-arms. A revival of taste for walnut wood furniture, incited by the intrinsic beauty of

its silver grain, and by improvements in cutting veneers, has increased the demand until its commercial value exceeds that of rosewood and mahogany.

SNAKEWOOD (*Piratinera Guianensis;* natural order, *Artocarpaceæ*).—This is a beautiful wood, of a rich chestnut brown colour, mottled with cloudy amber-coloured spots, resembling the markings of serpents—a scarce wood, imported from South America in sticks, two or three inches in diameter, and five or six inches in length. When dry, snakewood readily ignites if rubbed against wood harder than itself, and is so used for obtaining fire by the native Indians.

SATIN WOOD (*Swietenia chloroxylon*, L.; natural order, *Cedrelaceæ*).—A handsome, hard, yellow, veneering wood, imported from India, the West Indies, and South America, in logs seven or eight inches square and ten feet in length, for cabinet-makers and upholsterers in inlaying work, and picture-frames.

The greatest proportion of our building timber consists of the wood of various coniferous trees, which we import from America, Northern Europe, and Switzerland. The deal used in carpentry is the wood of several species of pine and fir. Thus, white deal is furnished by the Norway spruce fir (*Abies excelsa*, L.); yellow deal by the Scotch fir (*Pinus sylvestris*, L.); the silver fir (*Abies picea*, Link.) furnishes a whitish deal much used for flooring. There are numerous others, as the American and European larches (*Larix Americana*, Michx., and *L. Europœa*, L.); the hemlock spruce fir (*Abies Canadensis*, Michx.), which are employed for ship and house building. The names only of the trees —European, Asiatic, African, American, and Australian— which yield valuable furniture and building materials, would form an extensive catalogue.

## V. Plants producing valuable Gums, Resins, and Balsams.

*Resins* are the inspissated or thickened juices of plants, and are commonly associated with an essential oil; they are insoluble in water, but are dissolved by alcohol and essential oils.

*Gum Resins* or *Balsams* are partly soluble in water, from the quantity of gum they contain; partly also in spirits, on account of their resinous nature, but not freely in either fluid. The undissolved particles of a balsam mix intimately with the fluid, just as cream floats in oily globules in milk. Such an intermixture is an *emulsion*, as, for example, the emulsion of myrrh.

*Gums* are soluble in water, but not in alcohol.

Balsam Fir (*Abies balsamifera*, Michx.; natural order, *Coniferæ*).—This tree furnishes the Canada Balsam so much used in mounting microscopic preparations of objects of natural history, as it not only preserves, but at the same time gives them transparency. The oleo-resinous fluid is contained in blisters of the bark, which are punctured, and the balsam is then caught as it exudes. Imported from America.

India-rubber, Gum-elastic, or Caoutchouc, is the hardened milky juice of many euphorbiaceous plants and others. That from the Brazils is the produce of *Siphonia elastica* (Rich.), a noble tree, growing to a height of sixty feet, with a light, stone-coloured bark. That collected in Central America, and now an important article of export all along the Atlantic seaboard, is obtained from *Castilloa elastica*. The Brazilian method of obtaining the caoutchouc, or india-rubber, is to spread the milky juice upon clay moulds, and dry it in the sun or in the smoke of a fire,

which blackens it. The moulds are in the form of balls, bottles, and shoes. The juice is collected from incisions made in the stem, and is received into a cup of clay placed under the wound. It flows freely, to the extent of about four ounces daily, from each tree. This juice is then smeared over the clay moulds in successive layers, which are dried separately, until a sufficient number have accumulated to give a proper thickness; the clay is then washed out, and the india-rubber is ready for the market.

In Central America the juice is collected from incisions made in the stem, and is received into vessels. A tree four feet in diameter will yield twenty gallons of juice, each gallon producing two pounds of good dried rubber; and an industrious man will collect twenty-five gallons a day. The milky juice is strained through a wire sieve, so as to exclude all impurities before it is transferred to barrels, in which the real manufacture of the rubber is performed. The best manner of converting the milk into rubber is by mixing with it the juice of a certain vine, termed by the natives *achucà*, which has the singular property of producing coagulation within the space of five minutes. About a pint of the infusion of the vine is well mixed with every gallon of the milk. This is done in a large tin pan, and the rubber separates as a soft mass from the brown liquid. This mass is then placed on a board, slightly pressed by hand, and rolled out with a piece of heavy wood. A great quantity of water is thus squeezed out, and the rubber, which has now assumed its elasticity, is made into flat round cakes a quarter of an inch thick, twenty inches in diameter, and perfectly white in colour.

Hitherto the greater portion of the caoutchouc imported has been received from South America, but latterly a considerable amount has come from Singapore, Assam, and other places in the East Indies. This is the product

of the *Ficus elastica*, L., having close affinity to the famed banyan tree, so celebrated for its pillared supports, "whose daughters grow about the mother tree," and which has furnished the motto "*Tot rami quot arbores*" to the Royal Asiatic Society. A source of supply from a species of *Landolphia*, a climbing plant compared to a boa constrictor, has opened up in the West Coast of Africa. Para rubber commands the highest value for its purity, due more to care in its collection and preparation than from inherent difference in its properties.

Although for a long while after its introduction this invaluable hydrocarbon was merely regarded as a commercial curiosity, and served no higher purpose than rubbing out black lead pencil marks, whence its name, its applications to the industrial arts are now manifold and added to every year.

GUTTA-PERCHA (*Isonandra gutta*, Hook.; natural order, *Euphorbiaceæ.*)—This is a magnificent tree, sixty or seventy feet in height and from five to six feet in diameter, growing in the Malayan archipelago. Gutta-percha is the inspissated juice of this tree, and is procured as follows;—The trees are felled, the bark removed, and the milky juice which is found between the bark and wood is collected and poured into a trough made from the stalk of the plantain-leaf. It quickly coagulates on exposure to the air, and is then kneaded into cakes for exportation.

Gutta-percha (pronounced pertscha) is one of the most valuable vegetable productions of the age. When cold and hard, it is unctuous to the touch and elastic, but loses these qualities in warm water, in which however it is insoluble, though it readily dissolves in naphtha or alcohol. Gutta-percha is opaque, inflammable, and so tough, that a slip of the eighth of an inch will sustain-weight of over forty pounds. A great variety of articles are made from gutta-

percha; above all, cables for marine telegraphs, which without this useful discovery could not have extended so rapidly. Softened by hot water, it is moulded into any figure, retaining the shape when cold. By kneading, too, any number of pieces can be perfectly welded into one. Hitherto a spendthrift process has been pursued, in the wholesale destruction of the trees, in order to furnish the supplies; from eight to ten trees, being felled for every hundredweight of the gutta-percha yielded.

A short time ago this tree was abundant on the island of Singapore; now few if any other than small plants are to be found there, all the large trees having been felled. The range of its growth appears, however, to be considerable, as it doubtless extends over all the islands of the Malayan archipelago; and happily several other sources are known.

Tar (*Pinus sylvestris*, L.; natural order, *Coniferæ*).—Tar is an impure turpentine, viscid, and brown black in colour, procured by destructive distillation from the roots of various coniferous trees, particularly the above species. This process was known to the ancients, being described by Theophrastus, and is nearly the same now as in his time.

A bank is chosen near a marsh or bog, as the roots of pines so situated always yield the greatest supplies of tar; in this bank a conical cavity is formed, the sides of which are beaten down and rendered as firm as possible with heavy wooden mallets. A cast-iron pan is placed at the bottom of the hole or funnel, with a spout which projects through the side of the bank, and barrels are placed beneath this spout to collect the tar as it comes away. This cavity is then filled with the roots of the pine, which are cut and neatly packed so as to fill up the entire space, and the whole is covered over with turf and beaten down with the mallet or stamper. The roots in the inside of the cavity are then set on fire, and the tar, as it distils, runs down the

sides into the iron pan, passing through the spout into the barrels, which, as fast as filled, are bunged, and are then ready for exportation.

Tar is used chiefly by seamen, for preserving cordage and wood from the effects of the atmosphere. Tar comes from Russia, Norway, and Sweden; the United States, also, supply us with a considerable amount; the forests between Bayonne and Bordeaux in France, the Black Forest, and the forest of Thuringia, in Germany, send large quantities into commerce.

Pitch is tar condensed or deprived of the more volatile parts of distillation. The tar is boiled in an open iron pot until all the volatile matters are driven off; the residuum remaining is pitch. This is a black, solid, and glossy substance, very brittle when cold, but softening and becoming ductile when heated. That used in this country is mostly home manufactured. Pitch is frequently remixed with tar, and used for similar purposes, in shipbuilding, for caulking the seams of vessels.

TURPENTINE PINE (*Pinus palustris*, Wild., and *Pinus Tæda*, L.; natural order, *Coniferæ*).—The importation of turpentine by other nations is not very considerable, since almost every country possesses trees from which it may be procured. England, however, is an exception, the demand for turpentine being much greater than the home supply. We receive nearly all our turpentine from the United States, and it is obtained from the above two species of *Pinus*. There are also in the market, Bordeaux turpentine, obtained from *Pinus pineaster*, Aiton; Strasburg turpentine, from *Abies pectinata;* Venice turpentine, from *Abies larix* (Rich.), the common larch; and Chio turpentine, from the *Pistacia terebinthus* (L.), a tree indigenous to Cyprus.

The process of collecting turpentine is in each case nearly the same. The bark of the tree being wounded, the

turpentine trickles out in drops into boxes or other vessels placed so as to receive it. The incisions are made about the close of the month of March, and the turpentine continues to flow throughout the vegetative season, particularly during the summer months.

Turpentine is imported in barrels, weighing from two to two and a half cwts., and has the appearance and consistence of honey. Oil or spirits of turpentine is obtained by distillation from the raw turpentine; the residue is the common resin or rosin of the shops. Spirits of turpentine, as a solvent of all resins, is much used in the preparation of paint and varnish; and rosin in the manufacture of common soap, common sealing-wax, for the bows of violins, and for caulking ships.

The turpentines are invaluable in medicine. They are prescribed in affections of the lungs and other disorders.

GUM-ARABIC (*Acacia vera*, Wild., and *Acacia Arabica*, Wild.; natural order, *Leguminosæ*).—Gum-arabic is produced by these two trees, which grow in abundance in Arabia, and in Egypt on the banks of the Nile. It flows spontaneously from their trunks and branches, in the form of a mucilage, which dries and hardens on exposure to the air. The more sickly the tree, and the hotter the weather, the more abundantly exudes the gum. It is very nutritious, and the Arabs who gather it almost live upon it during the harvest.

The principal African and Arabian ports for the exportation of gum-arabic are Aden, Mocha, Suez, Cairo, and Alexandria. Gum-senegal, the product of *Acacia Senegal*, (Wild.), is the best and dearest sort of Arabian gum. It is distinguishable from gum-arabic by its clearness, consisting of choice drops or tears, some as large as a pigeon's egg, entirely white, and shining like glass. Gum-tragacanth, which is yielded by *Astragalus tragacantha*, L., is also con-

siderably in demand, and is one of the chief gums of commerce. We receive this gum from Greece and Asia Minor. The principal place for its exportation is Smyrna.

These gums are chiefly used in the manufacture of silks, crapes, and muslins, to stiffen and glaze the fabric; they are employed also in calico-printing, to give consistence to the colours; in medicine, painting, and in the manufacture of ink. British gum or Dextrine, much used in the arts for stiffening fabrics, is prepared from starch.

GUM-SANDARACH (*Callitris quadrivalvis*, Verst.; natural order, *Coniferæ*).—This tree is a native of Barbary, on the African coast. The Turks construct the ceilings and floors of their mosques of its wood, which is all but indestructible. The gum is much used in making fine varnishes. The gums proper enter into a great number of pharmaceutical preparations.

GAMBOGE (*Garcinia morella*).—Gamboge is a gum-resin obtained from this tree, which grows wild on the Malabar and Ceylon coasts. In Ceylon gamboge is obtained by wounding the bark of the tree as soon as the flowers begin to appear. It appears in commerce in three forms—in solid rolls or cylinders, in hollow rolls or pipes,—in tears, and in amorphous masses or cakes. Gamboge is imported from Ceylon, Siam, and Cochin-China. The best is the pipe-gamboge from Siam.

Gamboge is employed as a water-colour or pigment by artists, also in medicine as a drastic purgative.

CAMPHOR TREE (*Laurus camphora*, L.; natural order, *Lauraceæ*).—The camphor tree is a native of China, Japan, Borneo, and the island of Formosa. Camphor may be regarded as a solid volatile oil and is obtained by the following process:—"The wood of the *Laurus* is cut into small pieces, and put, with plenty of water, into small iron boilers, which are covered with an earthen dome lined within with

rice straw. As the water boils the camphor rises with the steam, and attaches itself as a sublimate to the stalks, under the form of granulations of a grey colour. In this state it is picked off the straw, and packed up for exportation to Europe."* The purest camphor is in "tears" or solid accretions in the tissues of the plant.

Camphor is brought to this country in chests, drums, and casks—in small granular, friable masses, of a dirty white or greyish colour. It is much used in museums and private collections of natural history, as a preservative of animal and vegetable bodies against the depredations of insects. The most effective way to accomplish this purpose is to construct the cabinets with the wood of the camphor laurel. It is also used in medicine, in the composition of varnishes, and in the manufacture of fire-works.

FRANKINCENSE (*Boswellia Carterii*, &c.; natural order, *Amyridaceæ*).—This is an odoriferous gum-resin, much used by the Roman Catholics in their churches. It was employed by the priests of ancient Egypt to conceal the unpleasant emanations arising from the sacrifices offered in their temples. It is imported from India and the Levant.

BENZOIN OR GUM BENJAMIN is a choice balsam, exuding from trees in Siam, Sumatra, and Penang. This fragrant incense, of which the Siam variety is the finest, besides its use in religious rites and ceremonies, finds extensive application as a fumigator for sick rooms, in making scented waters, and as an important medicinal drug. Its collection in Siam is a monopoly, and its first cost ranges as high as a guinea a pound avoirdupois.

ASAFŒTIDA (*Narthex asafœtida*, Falconer; natural order, *Umbelliferæ*).—This fetid gum-resin exudes from incisions made in the roots of the plant. It is first a milky juice, but when dried in the sun, acquires a mottled appearance and a

* Ure's "Dictionary of Arts, Manufactures, and Mines."

pink colour. The plant is indigenous to the south of Persia, Affghanistan, and the Punjaub. Asafœtida usually comes over in casks and cases. It is much used in medicine as a valuable stimulant and anti-spasmodic, in cases of asthma and spasmodic cough. The tears of asafœtida become adhesive when warmed, but when exposed to an excess of cold are so brittle that they may be powdered. The balsam is eaten as a condiment in Persia and other regions, recommended by its powerful resemblance in odour and taste to garlic. The leaves of the plant also are cooked as a pot herb or kitchen vegetable.

## VI. The Barks of Commerce.

Many varieties of bark are known in commerce, the chief of which are those used for medicinal purposes, such as the Peruvian and Cascarilla barks; and those which are employed in the arts and manufactures, or economic barks, such as the bark of the cork oak, and the valuable tanning bark of the common oak.

### *Medicinal Barks.*

Cinchona or Peruvian Bark (*Cinchona Condaminea*, Humb. and Bonpl., &c.; natural order, *Cinchonaceæ.*)—Cinchona bark is the product of various species of Cinchona, a group of evergreen trees and shrubs growing on the slopes of the Andes in Peru and Bolivia, at elevations varying from 7000 to 10,000 feet above the level of the sea.

The medicinal properties of this bark are entirely owing to the presence of three alkaline and bitter principles, quinine, cinchonine, and quinidine, which are the most effective remedies known against intermittent and allied fevers. The Jesuit missionaries were the first to discover and make known its value as a remedial agent, and for a long time they were the sole vendors of it, whence its name of "Jesuit's

Bark." The generic name *Cinchona* was given to the plant because, in 1638, the Countess of Chinchon, wife of the Viceroy of Peru, was cured of intermittent fever by its use; hence, also, the powdered bark was called *Pulvis Comitissæ*, or Countess's powder.

There are, at the fewest, twelve species of *Cinchona* from which the bark of commerce is derived. All these resemble each other in their general features; finely veined leaves traversed by a strong mid-rib and a thick leaf stalk, often of a fine red. The principal varieties of Peruvian bark recognised in the Pharmacopœia are the *pale*, the *yellow*, the *red*, and the *crown* bark. These tonic barks are powdered and administered, sometimes with wine as a vehicle, but the greater number are consumed solely in the preparation of quinine. The artificial production of quinine by the chemist, lately accomplished, has reduced the costliness of the natural product to half its previous amount. The pale bark contains most cinchonine, the yellow most quinine; Loxa or crown bark the largest proportion of quinidine; the red yields the alkaloids in about equal proportions.

Peruvian bark comes to us in the form of quills or hollow cylinders, which vary in length and diameter, the longest seldom exceeding two feet—the diameter varying from a quarter of an inch to two inches. These quills are the bark of the smaller branches of the tree, which rolls up thus as it dries in the sun. Pale bark arrives in quills only; the Calisaya or yellow bark, and also the red bark, come both in quills and flat pieces, which last are derived from the trunk, and reduced to this form by being alternately exposed to the sun and then subjected to pressure until perfectly dry. Peruvian bark is usually imported in packages, or *serons*, made of dried cow-hides. The cinchona plant has been introduced with every prospect of

success into British India, where large plantations are now established in many of the hilly districts; and more recently into Japan and the Mauritius.

CASCARILLA BARK (*Croton Eleutheria;* natural order, *Euphorbiaceæ*).—This tree is a native of St. Domingo, the Antilles, and the Bahama Islands. Its bark is imported chiefly from Eleuthera, one of the Bahamas, and comes in small-sized quills and in chips. Cascarilla bark has strong aromatic and tonic properties, and is an excellent remedy in chills and fever, being occasionally employed as a substitute for cinchona. When burned it gives forth a sweet musky odour, and is often used in fumigations. The amount annually received in this country is from ten to twelve tons.

CEDRON (*Simaba cedron*, Aubl.; nat. ord., *Simarubaceæ*).—The cedron is a small tree confined to the republic of New Granada, ranging from about the fifth to the tenth degree of north latitude. Every part of the plant, but especially the seed—owing to the presence of an alkaloid (*cedrine*)—is intensely bitter. On account of this principle, the plant is employed with considerable success, in cases of intermittent fever. The chief reputation of the cedron rests upon its being considered an efficacious antidote for the bites of snakes, scorpions, centipedes, and other noxious animals; and so highly do the natives of the land in which it grows value it, that they will pay a large price for a single seed.

QUASSIA AMARA, belonging to the same order as the cedron, is a more valuable febrifuge. Of it are made the quassia cups and chips, esteemed for their bitter tonic properties.

## VII.—TANNING MATERIALS.

In the bark of certain trees a peculiar light yellow glistening substance exists, called *tannin*, or tannic acid,

which consists of small yellow crystals. This tannic acid has the power of combining with the gelatine in the skins of animals, and converting them into leather by forming a tannate of gelatine. The most valuable bark for this purpose is that of

OAK (*Quercus pedunculata;* natural order, *Cupuliferæ*).—Indigenous to this country, and also much cultivated. We import large quantities of oak bark from Holland and Belgium, though hardly more than a tithe consumed of home growth.

VALONIA (*Quercus ægilops*).—Under this name the acorn-cups of this species of oak are used; although the tree is dwarf and shrubby, these cups are very large and much prized by tanners. Large quantities are imported from the Levant, chiefly *viâ* Smyrna. Sometimes these acorns are gathered before they are fully formed; they are then called *camata*, or *camatina*, and are more valuable. Valonia contains much less of the tanning principles than oak bark, but its comparative cheapness causes it to be in great request.

NUT-GALLS (*Quercus infectoria*).—This tree abounds in Asia Minor. The galls are excrescences upon the young twigs, produced by the punctures of an insect, a species of *Cynips*. The market is chiefly supplied from the ports of the Levant, whence they are called Aleppo galls. They contain much tannin and gallic acid, and are largely employed both in tanning and dyeing. We receive them from Cyprus, Turkey, Greece, the Ionian Islands, Hungary, and Sclavonia, *viâ* Vienna, Trieste, Leghorn, Genoa, and Marseilles. One kind, called the *knoppern*, is distinguished from the smooth gall-nuts by many angular and rough excrescences, as well as by having the essential principles in greater strength.

DIVI-DIVI (*Cæsalpinia coriaria;* natural order, *Leguminosæ*).—This tree is a native of the salt marshes of

Curaçoa, Carthagena, and other places in South America. It furnishes in abundance a brown pod, about the size of that of the pea, but curved into the form of the letter S. This pod is very astringent, and therefore of great value in tanning. The Indian name, divi-divi, has been adopted by our merchants. It is not used alone, but is generally mixed with oak-bark and valonia.

CATECHU (*Acacia catechu ;* natural order, *Leguminosæ*).—A thorny tree ; a native of Hindostan. Catechu is procured by cutting the wood into chips, boiling them, and then straining the liquor, and evaporating it until it assumes the appearance and consistency of tar. This substance hardens as it cools, is formed into small squares, dried in the sun, and is then fit for market. Catechu contains a large proportion of tannin. Packed in mats, it is sent to this country in large quantities from India. Dissolved in water, it tans skins very rapidly—one pound of catechu being equivalent to seven or eight of oak bark ; but the leather is not so durable or good as that which is more slowly prepared from oak bark. Other tanning principles allied in character to catechu, though extracted from different oriental plants, are known in commerce as terra japonica or gambier and cutch, the imports of which substances, in the gross, are very considerable.

BETEL-NUT PALM (*Areca catechu*, L.) grows in most parts of the East Indies. The trunk is straight and slender, and from forty to fifty feet in height ; the fruit is about the size and shape of a small egg, and the nut itself rather larger than a nutmeg, roundish-conical, and brown in colour.

The betel-nut furnishes an astringent extract, which constitutes one or more varieties of the catechu of commerce. The principal consumption of the betel-nut is for chewing, in combination with the pepper leaf of the *Ohavica betel* and lime. The seeds are cut into thin slices. A slice

is then taken in a betel leaf smeared with white coral lime, and chewed. Indulged to excess, betel chewing produces intense salivation; causes the gums to swell and redden, and destroys the teeth. The craving for the betel arises from its narcotic powers. It is in general use as a masticatory amongst the natives of the East Indies, much the same as tobacco in other countries.

Tanning principles are diffused through the botanical kingdom. Christie's "New Commercial Plants and Drugs" for 1882, gives a list of 133 plants yielding tannin, and in actual use in thirteen different countries of the world. These plants comprise annuals, shrubs, and trees, the tanning principle varying widely in its properties as also in the organs where it is present. Barks, roots, wood, leaves, fruit, galls, nuts, acorns, acorn-cups, seed-pods, and extracts, are all in turn utilised. In this wide field of choice, and many more remain to be brought into the commercial list, oak bark maintains the front place as a tanning material, and the tanner's art still depends upon the chemist to devise means of economising time in the process of leather-making. The urgency of progress in this industry, which seemingly lags behind the age, is enforced by the results of recent experiments with pure extracts. Thus a firm of tanners turning out an average of 1000 hides a week at a cost of 50s. each, according to the old fashion, taking three years in the process, now convert the hides into good leather in the space of six-months at a computed saving of £330,000. The importance of such economies is emphasised by the fact that there are nearly 1000 tanneries in the United Kingdom, working up about 200,000 tons of hides and skins yearly, and consuming foreign tanning substances in the process, to a value approximating £150,000.

## VIII.—Plants Remarkable for their Narcotic and Poisonous Properties, yet useful as Remedial agents.

Opium (*Papaver somniferum*, L.; natural order, *Papaveraceæ*).—The poppy is an annual plant growing from two to four feet high, having flowers with two sepals and four white petals, with a violet spot at the base of each petal. Stamens numerous; pistil, a globular ovary or capsule, surmounted by a radiated stigma, containing partial dissepiments, and numerous seeds.

The opium poppy is a native of Persia, and probably also of the south of Europe and Asia Minor. It is largely cultivated in those countries, and also in Egypt, Arabia, and British India, for the sake of its opium. Dr. Joseph Hooker thus describes this process;—"The capsules are sliced in February and March with a little instrument like a saw, made of three serrated plates tied together. From the incisions made by this instrument the opium oozes out as a milky juice, which as it dries becomes a soft brown sticky paste; each morning this paste is scraped off by means of small shells, and collected into jars, the contents of which are afterwards made into balls of about half a pound weight, these are often coated with the seeds of some species of *Rheum* or rhubarb plant. The balls are packed into chests, and exported to other countries."

Opium is produced in large quantities in India for consumption in China, on account of the great sale there, in spite of all prohibitions. Eastern nations generally are very fond of opium, which they smoke with their tobacco, or alone, and take in the form of pills. With us, it is much used in medicine as an anodyne, generally in the well-known preparation called laudanum. Turkey opium is considered to be the best, especially that which comes from

Smyrna. Its production in India is the source of a large revenue; but public opinion is strongly divided on the morality of our growing a drug so liable to perverted and vicious consumption.

TOBACCO (*Nicotiana Tabacum*, L.; natural order, *Solanaceæ*).—The tobacco plant is an annual, growing six feet high. The leaves are viscid and pubescent, and are the parts used in the manufacture of the tobacco.

The tobacco plant is indigenous to the warm parts of America, and was unknown in the Old World before the discovery of that continent. It was first brought to the notice of the Spaniards in 1492, when Columbus and his companions saw the natives of Cuba smoking cigars. It was introduced into England in 1586 by Sir Francis Drake, from Virginia, where an English colony had remained for a year. The colonists are said to have brought tobacco with them on their return, and to have introduced into this country the practice of tobacco-smoking, or as it was at first called, tobacco-*drinking* or *sucking*. Sir Walter Raleigh and other young men of fashion gave it every encouragement, and the habit of smoking was soon acquired by the English, as it had previously been by the Spaniards, the first method of imbibing the fumes being by means of a walnut-shell and a straw. The tobacco plant appears to thrive in all warm climates. Its cultivation in the United Kingdom, especially in Ireland, has earnest advocates. Some experimental crops of the finest varieties of leaf have been grown, under government sanction, with eminent success; but excise restrictions, if not climatic conditions, have barred its general culture. The practice of smoking has become almost universal both amongst savage and civilised nations; for no habit is more easily acquired or more difficult to relinquish than the use of this weed, hence its rapid progress amongst nations, despite of all the efforts of their rulers at prohibition. The

priests and sultans of Turkey and Persia declared smoking to be a sin against their holy religion; yet the Turks and Persians became the greatest smokers in the world. Pope Urban VIII. fulminated a bull against the use of tobacco, but the anathema fell to the ground. In Russia the smoker was threatened with the knout for the first offence, and with death for the second; yet the Russians are now constantly with pipes in their mouths. In our own country James I. wrote a book against it, called "A Counterblaste to Tobacco;" but instead of checking, it rather tended to promote the spread of the habit among his subjects.

Tobacco is manufactured in various forms to fit it for smoking, chewing, or snuffing, and the annual consumption in these different forms is so enormous that no estimate can be made of the quantity. In some parts of the Continent, the tobacco industry is a government monopoly. In our own country, though the consumption is of such magnitude as to form a main prop of finance, other races beat us as smokers.

After the plants have done blooming they are cut down and hung up to dry on poles; the leaves are then stripped from the stems, sorted, packed in boxes or casks, and shipped. On arriving in this country the leaves are taken out of the casks, and when their midribs have been removed, are spread on the floor and moistened with water. This is all that English manufacturers are allowed to do; on the Continent salt and sugar are added. The leaves are then compressed into dense cakes, and cut with a machine; and the cut tobacco, shaken out and afterwards steamed, is called, according to the leaf used, *Virginia shag*, *Maryland returns*, &c. In *Bird's eye* tobacco the midrib is allowed to remain in the leaf, and forms those little white bits which have given it its fanciful name. The dried leaves, moistened with sugar and water, and pressed into cakes, form *Cavendish*

and *Negrohead*, used for chewing and smoking. The same leaves moistened with sugar and water, beaten until soft, and then twisted into a sort of string, constitute pig-tail. The leaves and stalks ground to powder and roasted form snuff, which is variously scented to suit the different olfactory tastes of customers. Cigars are only the dried leaves deprived of their midribs and wound into a sort of spindle form; cheroots are a variety of cigar, cut straight at each end, cylindrical, and tapering, broader at one end than the other; cigarettes are made by rolling up a small quantity of cut tobacco in a piece of paper (the leafy covering of the Indian corn is preferred), they are then smoked the same as cigars, but usually by moderate smokers.

There are numerous varieties of tobacco found in commerce. The principal sorts are:—

*North-American tobacco*, chiefly from the states of Virginia, Maryland, and Kentucky; but now, Tennessee, North Carolina, Louisiana, and Missouri also produce the weed. Usually imported in hogsheads in the leaf, hence called leaf-tobacco.

*South-American tobacco*, which is received in the form of cylindrical rolls two feet in length and one foot in diameter, made by rolling or twisting the fragrant leaves into a kind of rope about an inch or more in diameter, and then coiled up into these cylindrical rolls as the most compact and convenient form for transportation. We receive supplies from the Orinoco, Porto Rico, and from Maracaibo, and other South-American ports. Roll tobacco is sent over in baskets made of twisted cane, called *canastras*. A considerable quantity of South American tobacco comes from the Brazils, both in the leaf and roll form.

The tobacco of Cuba is considered to be the finest in the world: Havana makes the best cigars.

*Asiatic tobacco.*—Asia produces good tobacco, but mostly

for her own consumption. The European market, however, gets the Persian or Shiraz, which is much esteemed. Tobacco is also received from the Spanish island of Manilla in the shape of fine cigars, which are manufactured there, and then exported. A small quantity is sent from India, Ceylon, Java, and Sumatra. From Turkey, Latakia tobacco is imported, which consists of not only the leaf, but also the flowers and buds of the plant; it is so called after the Turkish province of Latakia (the ancient *Antioch*), where it is grown. The cultivation of tobacco in Borneo promises to be highly successful, the leaf being of the finest quality.

NUX VOMICA (*Strychnos nux vomica*, L.; natural order, *Loganiaceæ*).—A medium-sized tree, a native of the East Indies, very common on the coast of Coromandel. The fruit is a globular berry, about the size of an orange, and with a smooth, hard, yellow rind, containing five seeds embedded in the pulp. These seeds are circular, flattened, rather less than an inch in diameter, slightly concave, silky in appearance, and fawn-coloured, or light drab in colour.

Strychnine, the most energetic poison known, is procured from the bruised seeds of the *nux vomica*, which are imported from Coromandel and Ceylon. It is sometimes employed in cases of paralysis, and is much used as a poison for rats and mice. Strychnine is not restricted to the fruit of the nux vomica but occurs in the wood. The proportion of the alkaloid varies from $\frac{1}{4}$ to $\frac{1}{2}$ per cent.

## IX.—MISCELLANEOUS MEDICINAL PRODUCTS.

ALOES (*Aloe Socotrina*, Tournef.; natural order, *Liliaceæ*).—This drug is the bitter, resinous, inspissated or thickened juice which is obtained from the leaves of various species of arborescent aloes growing in tropical climates. The

species belong to the lily family, and have very large succulent leaves. The leaves are cut off close to the stem, and so placed that the juice is drained from them into tubs; this juice is then boiled until it acquires the consistence of honey, and poured into gourds or calabashes, when it hardens into a black compact substance, having an aromatic smell and an exceedingly bitter taste.

There are four principal varieties of aloes in commerce; 1. *Socotrine Aloes*, the best, produced by the above-named species, and so called from the island of Socotra, on the south coast of Arabia, in the Indian Ocean. Hardly anything is known with certainty either of the methods or the localities of manufacture of this superior variety of the aloes. 2. *Barbados Aloes*—of a very fine quality, produced by *Aloe vulgaris*, which is indigenous to the English island of Barbados, and also to Jamaica, Arabia, and the east coast of Africa. The Barbados aloes are imported from Barbados or Jamaica, usually in gourds weighing from sixty to seventy pounds, but sometimes in boxes holding about half a hundredweight. 3. *Cape Aloes*—very inferior, which is the product of *Aloe spicata;* raised in large quantities at the Cape of Good Hope, and brought over in chests and skins, the latter being preferred. 4. *Caballine* or *Horse Aloes.* This is the poorest kind; it is generally the refuse of the Barbados aloes, and, from its very rank and fetid smell, can only be used in veterinary medicine.

Liquorice (*Glycyrrhiza glabra*, L.; natural order, *Leguminosæ*).—This is a perennial plant, having long yellow fibrous roots running deeply into the ground, with an herbaceous stem four to five feet in height. Liquorice is a native of Italy, Spain, Sicily, and the southern parts of Europe; but it has been successfully cultivated in England, even from the reign of Queen Elizabeth, especially at Pontefract in Yorkshire, and Mitcham in Surrey. The

greatest portion of our supplies of that extract of the root which forms the common liquorice of the shops, is obtained from the Spanish provinces of Arragon, Catalonia, and Valencia. The juice, procured from the root by compression in a mill, is boiled slowly until it becomes of the proper consistence, and is then made into sticks or bars from six to eight inches long, which are usually covered with bay leaves, and imported under the name of Spanish juice. Liquorice in the form of paste, or of the root itself, is in common use as an emollient in catarrh or cough; the root is also much used by brewers in the manufacture of porter. Solazzi or Italian juice is the best.

IPECACUANHA (*Cephalis ipecacuanha*, Rich.; natural order, *Cinchonaceæ*).—This is a perennial plant growing in Brazil, about five or six inches high. The roots are several inches long, contorted, greyish brown, annulated, and about the thickness of a goose quill. The root of this plant affords a very important emetic medicine. It is imported from Rio Janeiro in bales, barrels, and bags. There are several varieties of ipecacuanha. Its growth has been encouraged in India, whereby our supplies have been considerably augmented.

RHUBARB (*Rheum palmatum*; natural order, *Polygonaceæ*).—This well-known purgative is the root of different species of *Rheum* growing in Tartary and other parts of Asia. There are two sorts, viz., Russian or Turkey rhubarb, which is brought by the Chinese to Kyachta, and there cleaned and sent on to Moscow and St. Petersburg; and the East Indian or Chinese rhubarb, which is shipped from Canton to Europe. The plant is a perennial, resembling our garden rhubarb but of a larger size. Our knowledge of the production and preparation of rhubarb for the market by the Chinese is meagre. The root is dug up in autumn, when the vitality of the plant is in the decline, then cleaned,

cut in pieces, and strung up for drying, either by the sun and air, or by artificial heat. The pieces, which are sorted into round and flat rhubarb, are often pierced with a hole with the remains of the string used to suspend them. To give the drug a bright appearance a brownish-yellow powder is dusted over the pieces. The cultivation of the root has been pursued with some enthusiasm in Europe, but the produce commands a low price. As a drug rhubarb is a bitter astringent, and purgative, with an odour regarded as very disagreeable.

Muscovitic or Crown rhubarb, once known as Turkey rhubarb, long enjoyed the highest reputation, but has become a thing of the past, from the unsparing supervision of Russia over the Chinese drug. The name of Turkey rhubarb has been retained for all that now comes through Russia.

JALAP (*Exogonium purga;* natural order, *Convolvulaceæ*).—This valuable purgative medicine derives its name from Xalapa in Mexico, where it is very abundant. It is a handsome climbing convolvulaceous plant with delicate pink flowers and a tuberose root. The tubers, varying in size from a walnut to an orange, are dark umber-brown in colour, and much wrinkled. A Tampico variety of jalap also enters into commerce, though not equal to other kinds.

CHAMOMILE (*Anthemis nobilis*, L.; natural order, *Compositæ*).—This is a well-known perennial plant, not unfrequent on dry, gravelly, or sandy heaths, and in the pastures of this country. The whole plant is intensely bitter, and an infusion of its flowers has long been esteemed as a tonic and stomachic, and used as an ingredient in fomentations. This plant is cultivated in England, and the flowers sold by druggists are the produce of the cultivated variety. Chamomile flowers are also largely imported from France, Holland, and Germany.

SARSAPARILLA (*Smilax officinalis;* natural order, *Smilaceæ*).—Sarsaparilla is the produce of several woody climbing plants inhabiting swampy forests and ascending lofty trees by the strong tendrils which spring from the petiole of the leaf. The plant springs from a woody rhizome or under-ground stem, often as much as ten feet long. Annulated roots, abounding more or less in starch, proceed from this stem, and constitute the sarsaparilla of commerce. The thick, knotty, rhizome of the medicinal species of Smilax is called by the druggists *chump*, and the long, fleshy, horizontal roots therefrom are clothed with thread-like branching rootlets technically known as *beard.* Dry sarsaparilla has little or no smell, but a large decoction of the drug gives off a very perceptible odour. Jamaica, whence so much sarsaparilla is exported, produces but little; the article known as Jamaica sarsaparilla being merely exported from the Spanish main for re-shipment. Sarsaparilla is imported in bales, and is known in the market as Lisbon or Brazilian, Honduras, Mexican, and Jamaica or red sarsaparilla, of which the last is the most preferred.

Sarsaparilla is now regarded as a powerful alterative medicine in cases of physical debility. Its usefulness is daily manifested in the public hospitals, in cases of broken-down constitutions, so common to the class of patients by whom those establishments are frequented. It is chiefly used in rheumatic and cutaneous diseases. A concentrated liquid extract and a syrup are now prepared, which are the best forms under which it can be taken. Some authorities nevertheless deny to the drug any remedial powers.

SENNA (*Cassia acutifolia* and *C. augustifolia*; natural order, *Leguminosæ*).—The senna leaves of commerce and medicine are afforded by the two species of Cassia named above; both small shrubs with simple abruptly pinnate

leaves, and yellow flowers, growing in tropical Asia and Africa. True senna leaves may be recognised by their oblique lower edges, and the inequality of their insertion into the foot-stalk ; their odour is very faint, and their taste is sweetish and nauseous. The following varieties are met with :—

ALEXANDRIAN SENNA (*C. augustifolia*) grows in Upper Egypt and Arabia. The harvest commences in September. The branches of the shrub are cut, collected into bundles, dried in the sun, and then threshed until the leaves are separated from them. This process breaks the branches, and the leaves thus become mixed with portions of twigs. The senna leaves so obtained are then put into sacks and conveyed to the Nile, and carried down the river to Cairo and Alexandria. There they are unpacked, sorted, and repacked in large bales, ready for the market.

Alexandrian senna formerly arrived in a very mixed and dirty state ; but of late it has been shipped of such quality that no question can be raised of its superiority to every other kind brought to European markets.

TINNEVELLY SENNA (*Cassia augustifolia*), is cultivated in India, but originated in Arabia and Africa. The leaves are longer and thinner than the rigid Alexandrian variety, yellowish green, with the fragrance of tea, and barely any flavour unless made into a decoction.

*Arabian*, *Mocha*, *Bombay*, or *East Indian Senna*, from the same species of shrub, is shipped from the Red Sea ports of Arabia to Bombay, whence it reaches Europe. It is an inferior senna, dried with little care, though not adulterated, and its value occasionally goes down to a farthing a pound. Senna is a popular drug, and the conserve is in much request.

## X. Miscellaneous Plants of Commercial Value.

Vegetable Ivory—Corozo Nuts (*Phytelephas macrocarpa ;* natural order, *Phytelephanteæ*).—The *Phytelephas*, twenty feet in height, resembles a dwarf palm, with a majestic tuft of pinnate leaves; it is a native of the low valleys of South America between 9° N. and 8° S. latitude, and between 70° and 79° W. longitude. Its nuts are enclosed in a large capsule about the size of a man's head, and, owing to the shortness of the stem, often rest on the ground. The albumen of the nut is "at first a clear insipid fluid, with which travellers allay their thirst; afterwards this same liquor becomes milky and sweet," consolidating by degrees till it becomes as white and hard as ivory. The nuts themselves, under the name of Corozo nuts, are imported in large quantities, being used by turners in making a vast variety of trinkets and articles to imitate ivory, the texture and whiteness of which they maintain for a time, but then deteriorate and become discoloured.

Coquilla Nut (*Attalea funifera*; natural order, *Palmaceæ*).—This is the fruit of a South and Central American palm. It is a nut of not more than three inches in length and two in breadth, and is completely solid, excepting a small cavity in the centre, in which the seed is deposited. The shell is, therefore, very thick, and it is also very hard, taking a fine black polish. Coquilla nuts are used chiefly by ornamental turners for the production of small knob handles for cabinet drawers, parasol and umbrella handles, chessmen, rings, brooches, and small toys. The same palm affords piassaba fibre.

Marking Nut (*Semecarpus anacardium ;* natural order, *Anacardiaceæ*).—A native of the East Indies. This nut, somewhat of a heart shape, has an exterior covering formed of two laminæ, between which is a caustic bitter

juice or pulp staining an indelible black, much used as a black varnish, as well as for marking linen, whence its name of Marking Nut. The colour is improved and prevented from running by mixing with lime water.

Tonquin Bean (*Dipterix odorata*; natural order, *Leguminosæ*).—These beans are chiefly found in Cochin China, and exported from Tonquin. The seeds of the Tonga or Tonka tree, a native of Guiana, are used, under the same name, to impart fragrance to snuffs.

Orris Root (*Iris Florentina*; natural order, *Iridaceæ*).—This plant is a native of Italy, and cultivated in gardens. Orris root is used as an ingredient in tooth powders, and in the perfumed preparation of wheat starch called violet powder, as well as in hair powder, articles of perfumery, and in flavouring liqueurs.

Crabs' Eyes (*Abrus precatorius*; natural order, *Leguminosæ*).—This is a pretty climbing plant, a native of the West Indies. Its seeds are bright scarlet, jet black round the hilum, and very handsome. Coral beans are used by the native druggists and jewellers as weights, being almost uniformly one grain. They are strung together for necklaces and rosaries, as are the crabs' eyes, and a fancy obtains that they are a useful medical drug in cases of ophthalmia.

Cork Oak (*Quercus suber*).—This tree closely resembles the *Quercus ilex*, L., or evergreen oak, so well known in English shrubberies. It is indigenous to the mountainous regions of Spain, Portugal, and the South of France. It grows from thirty to forty feet high, and from two to three feet in diameter. Spain and Portugal supply the greatest portion of the cork which is used in Europe; abundant supplies are also received from the South of France at the foot of the Pyrenees, the islands of Sardinia and Corsica, and the forests of Algeria.

When this tree is about five years of age, the cork, which composes the greater part of its bark, begins to increase in a very remarkable manner. Nearly all its vegetative activity seems to be concentrated on this part, which grows unusually large, thick, and spongy. If left on the tree it becomes cracked and so deeply fissured that it is unfit for use. It is therefore removed before this happens. Its removal does not injure, but is beneficial to the tree, for if the cork is allowed to remain on its stem, the cork-oak seldom lives longer than fifty or sixty years; if, on the contrary, it is removed, the tree flourishes sometimes for upwards of 150 years. After the tree is thirty years old, its cork may be removed at intervals of from six to ten years. The first crop of cork is generally inferior in quality, and is principally used for making floats for fishing nets. The crops are usually gathered in the months of July and August. Two opposite longitudinal incisions into the bark are made the whole length of the stem, and then several transverse ones about three feet apart. The bark is now beaten to separate it from the subjacent liber, and detached in cylindrical pieces by inserting under it the handle of the instrument, which is curved and made thin at its extremity for this purpose. In effecting this removal great care is taken not to injure the newly-formed suber or cork—viz., the living layer of cork beneath. After barking, the pieces of cork are slightly charred to close the pores, then loaded with weights to flatten them, and finally stacked in square masses in some dry place, where they remain for two or three months. In drying they lose about one-fifth of their weight.

Only when the trees are forty or fifty years old is the bark sufficiently matured for making good corks. This substance is valuable for bottle corks, because it is light, porous, compressible, and sufficiently elastic to adapt itself to the neck of a bottle. It can be cut into any shape, and,

notwithstanding its porosity, is impervious to any common liquid. These qualities make it superior to all other substances as a stoppering for bottles, for which it is principally used. Corks are made as follows:—

The cork is first cut into slips, which by means of a gauge are made narrow or wide, according to the size of the corks or bungs ordered; these slips are then cut into squares of the required length, which are cut circularly with a knife by the hand, and thrown into a basket. Cork-cutting in Catalonia and the South of France is a branch of manual labour which furnishes a livelihood for a considerable portion of the population. Several attempts have been made to cut corks by machinery, but they have hitherto failed to supersede hand labour.

Cork is largely manufactured into soles for boots and shoes. Cork legs, hat frames, mattresses, bolsters, life-preservers, and life-boats are also manufactured from cork. Coffins were made of it by the ancient Egyptians. Many of the wealthier inhabitants of Spain have their houses lined with cork, which ensures the freedom of the rooms from damp. Cork, in thin slips, is used by entomologists as a lining to drawers and cabinets in which to fasten their insect pins. Spanish black and a black colour for painters are made from the calcined parings of cork. Virgin cork has come into request for rustic decorations and window gardening.

BALSA (*Ochroma Lagopus:* natural order, *Sterculiaceæ*).—The wood of this tree, being soft and light like cork, is used for stopping bottles. The never-sinking rafts, which at the discovery of South America caused such surprise, were constructed of it, and are so still. This tree prevails along the coasts of South America and the West Indies. The silky hair of the capsule of this plant, as well as that of other species of the order, is employed for stuffing pillows

and cushions. Balsa is a curiosity rather than a constituent of British commerce.

SODA and POTASH, which occur abundantly in plants, are important articles in commerce, and the plants which yield them are therefore deserving of notice. A large proportion of the plants growing on sea-coasts contain soda, whilst inland plants contain potash. Various species of *Salsola*, especially *S. kali*, *S. Salicornia*, and *S. Kochia*, furnish the soda of commerce. The best soda comes to us under the name of barilla, which is, in fact, the incinerated ash of *Salsola kali*. This plant is carefully cultivated in the Spanish provinces of Murcia, Valentia, Carthagena, Malaga, and Alicant, which carry on a considerable trade in the article.

"The seed is sown in light soils, which are embanked towards the sea-shore, and furnished with sluices for admitting an occasional overflow of salt water. When the plants are ripe, the crop is cut down and dried, the seeds are rubbed out and preserved, and the rest of the plant is burnt in rude furnaces, at a temperature just sufficient to cause the ashes to enter into a state of semi-fusion, so as to concrete on cooling into cellular compact masses. The most valuable variety of this article is called *sweet barilla*. It has a greyish-blue colour, and becomes covered with a saline efflorescence when exposed for some time to the air. It is hard and difficult to break; when applied to the tongue it excites a pungent alkaline taste."* An inferior soda is made in France, England, Ireland, and the Shetlands, from sea-weed, and brought into commerce under the name of kelp. Large revenues are derived by the proprietors of the shores of the Scottish islands from the incineration of sea-weed by their tenants, who usually pay their rent in kelp. Carbonate of soda is now made from common salt (chloride of sodium),

* "Ure's Dictionary of Arts, Manufactures, and Mines," vol. iii. p. 705.

yet the burning of sea-weed, &c., is still largely followed for the sake of the iodine contained in the ashes.

*Potash* is prepared for commerce by evaporating in iron pots the lixivium of wood-ashes; hence the name potash. The potash in plants is very soluble in water. If the wood-ash, which is an impure carbonate of potash, be put into water, and quick-lime be added to the solution, the lime will abstract the carbonic acid from the carbonate of potash, and form an insoluble carbonate of lime, which will be precipitated, and the potash will be taken up by the water, which will thus be rendered powerfully alkalinic. The lixivium or clear alkaline liquor thus obtained is then decanted off, and evaporated to dryness in iron pots, the residuum is calcined to remove all organic matter, and the product thus obtained forms the crude potash of commerce. The different varieties of potash are named either after the locality in which they are produced, or the route by which they arrive. Thus we have American, Russian, German, Illyrian, Saxon, Bohemian, and Heidelberg potashes. When still further purified, by additional calcination, potash is termed pearl-ash.

Potash can only be obtained abundantly in countries where there are vast natural forests, and where wood is so cheap that it only costs the labour of felling and hauling. In many parts of America, where timber is an encumbrance on the soil, it is felled, piled up in pyramids, and burned, solely with a view to the manufacture of this product.

Potash is a very considerable article of commerce. Russian produce, exported from St. Petersburg, Riga, and Archangel, exceeds that of any other European state. From Poland, *viâ* Warsaw and Cracow, and from East and West Prussia, *viâ* Dantzic and Konigsberg, vast quantities are exported. A third of the large produce of Hungary goes to supply the demand in Bavaria and Saxony. The Harz district, the forests of Thuringia, and almost all parts

of Germany rich in wood, supply potash. In modern times, however, it is received in the greatest quantities from Canada and the United States, *viâ* Boston and New York.

Potash is largely consumed in the manufacture of glass, porcelain, earthenware, and gunpowder; in colour and chemical manufactories; and also in dyeing and bleaching.

TINDER.—The internal spongy portion of several species of *Polyporus*, soaked in a solution of nitre, forms tinder. The principal places for the production of this fuel are, besides Hungary, Poland, Sweden, and Alsace, the country around Ulm, Nuremberg, Augsburg, and Frankfurt in Germany. Germany supplies the French, English, and Dutch markets, and Sweden the countries around the Baltic.

FULLER'S TEAZEL (*Dipsacus Fullonum*; natural order, *Dipsacaceæ*).—This plant is closely allied to the Compositæ, and is valuable for its large conical composite flower-heads, which have hard stiff bracts, the sharp awns of which are hooked. These bracts remain after the flowers have died, and their points are so admirably adapted for raising the nap on woollen cloth, that no invention has yet been found to supersede them. Many carding machines have been introduced, but the best clothiers still prefer the teazel for finishing their cloth. For this purpose, the conical teazel heads are cut up into halves and quarters, and fixed into a cylindrical frame, with the hooked bracts outwards, which frame is made to rotate over the surface of the cloth, until the little sharp hooks of the teazel have scratched up the required nap. Teazel heads, under the name of weavers' carders, are an extensive article of commerce, and cultivated in France, Italy, Holland, Germany, and the West of England. Large quantities are annually imported into the United Kingdom from Hamburg and Holland. The teazels are made up into bundles for sale to the clothiers, each bundle containing from 9000 to 10,000 heads. In

addition to our home production, many million teazel heads are annually imported.

RATTANS (species of *Calamus;* natural order, *Palmaceæ*).—These palms yield the canes or rattans of commerce. They have very long slender stems, with leaves at considerable distances apart, and the climbing species reach the tops of the highest trees by means of the powerful whip-like prolongations from the midribs of the leaves. The stems contain a considerable amount of silex, which renders them hard and gives them a glossy appearance. C. *rudentum* produces stems 300 feet in length, which make excellent ropes of immense strength, and as such are used by the native Hindoos in catching elephants. *C. Scipionum* furnishes the walking-sticks known as Malacca canes. *C. rotang*, *C. rudentum*, *C. verus*, *C. viminalis*, and others are used in this country for the bottoms of chairs, couches, and the sides of carriages, and in India are made into baskets, mats, hats, and other useful articles. They are also used as ropes and cables, in the junks and coasting vessels, and take the place of chains in native suspension bridges.

The rattans are found in commerce in bundles, each cane being once or twice doubled up in order to make the bundle smaller and more compact; the canes are very seldom less than twelve or even sixteen feet in length. Millions of canes or rattans are brought to our markets every year, in bundles of a hundred canes. Holland also imports annually several million pieces. Bengal, Arracan, and the Sunda islands produce the greatest quantity of rattans, and Europe is supplied with them *viâ* London, Amsterdam, and Rotterdam.

Cultivated fields of waving canes are a frequent striking sight in Italy and other European states of the Mediterranean. These are another order (*Arundo Donax*), a giant

grass or reed, of as great an economic use in their own region as the bamboo in the tropics. Like osiers they flourish in the marshes, and are cut down in due season, their stumps being fired for ash to manure the soil, and springing into new shoots every year. For fuel, in countries like Greece, without forests, for domestic and thousands of industrial purposes, these South European canes rank as a necessary of life.

BAMBOO (*Bambusa arundinaceæ*; natural order, *Gra-minaceæ*).—This gigantic tropical grass is extensively spread over India, China, and Japan. It grows like a tree, shooting up with great rapidity in two or three months to a height of fifty or sixty feet. Its hollow stems, which attain a diameter of seven or eight inches, are much used for building purposes in the countries where it grows, and its young shoots serve as walking-canes. The Chinese make from the inner bast-like bark an inferior kind of paper.

BULRUSHES (*Scirpus lacustris*, L.; natural order, *Cype-raceæ*.)—The bulrush, or bull-rush, grows along the margins of rivers, lakes, and ponds, especially in Northern Europe and the Netherlands. This plant is used in making the seats of rush-bottomed chairs; it is also in great demand among coopers, who place it between the staves of casks intended to hold liquid. The pithy structure of the rush induces the swelling of the culm, and the interstices between the staves are thus closed, and the cask rendered water-tight. Many vessels laden with this rush arrive annually in England from Holland and Belgium, bringing thirty or forty tons of rushes each voyage. This is a very large quantity considering the lightness of the material. Many tons of bulrushes are annually imported into the United Kingdom.

SOFT RUSH (*Juncus effusus*, L.; natural order, *Juncaceæ*) —The pith of the common soft rush, as also that of *Juncus*

*conglomeratus*, is employed for making the wicks of rush-lights, which continue to be used, although not so much as formerly.

In Japan, the manufacture of mats, &c., from rushes, is a regular trade. The floors of their houses are covered with rush mats of great beauty and variety, and rush mats are the only carpets and beds used by the Chinese. A light sort of matting made of the same material is used as a window blind. The sugar sent home from the East Indies is packed in bags made of rush-matting. The size of the Japanese rush mats appears to be regulated by law, for they are all of the same magnitude throughout the kingdom, the only exception being the mats in the imperial palace at Jeddo. Rushes are also used for chair bottoms and baskets.

DUTCH RUSH (*Equisetum hyemale*, L.; natural order, *Equisetaceæ*).—Used for polishing hard woods, alabaster, marbles, and other substances, for which purpose it is well adapted, by the large quantity of silex which is contained in its cuticle. The invention of sand and emery papers in modern times has, however, now almost superseded this natural polisher. It is still much used in Holland, where it grows abundantly in low boggy ground; it is found in damp woods in this country, but is occasionally imported from Holland.

PAPYRUS.—With the introduction of vellum and parchment the demand for papyrus as a means of writing greatly decreased, and with the invention of paper, its industrial history ceased. In Egypt proper, where it formerly was produced in vast quantities, for its roots as food, bast for cordage, mats, baskets, and boats, as well as for leaves as a writing material, it is now extinct. We need to go to the upper reaches of the Nile to find it again self-grown.

Papyrus still retains an economic value as an ornamental

water-plant. It flourishes in profusion at Syracuse and through Sicily, whence all the hot-houses of Europe are supplied.

BAST (*Tilia Europæa;* natural order, *Tiliaceæ*).—The common linden or lime-tree is easily recognised by its unsymmetrical leaf, and the curious bract to which the peduncle or flower-stem adheres. In Northern Europe and Russia, bast mats, ropes, and twines are made from the inner fibrous bark of this tree. At the proper season the stems are cut longitudinally, and the bark is taken off in long strips. The outer bark is easily separated from the inner; and the latter dried constitutes the bast of commerce. This is plaited by the Russians into mats from a yard and a half to two yards square, which are much used by gardeners and upholsterers. These mats are also employed for lining the holds of vessels intended to receive corn. Millions of them are annually imported into the United Kingdom from various Russian ports, but chiefly from Archangel.

# PART III.

## THE COMMERCIAL PRODUCTS OF THE ANIMAL KINGDOM.

### *INTRODUCTORY.*

When we analyse the incipient desires and efforts of the human race, we find them comprised under the industrial heads of the means of food, warmth, and rest. These essentials once provided, man's intellectual aspirations find freer scope, and he rises in the scale of intelligence.

We have thus far followed the laws of causation, and classified for readier access the knowledge we have gained. We have sought other aid in books, which are more than the embodiment of practical experience: they are the pioneers to prepare and make ready the way for future generations to enter upon a heritage of truth and wisdom when starting for still higher knowledge.

We must pursue the same method of inquiry into the phenomena of animal life, and systematise our researches for easy reference. The great naturalists of the past have constructed a road, plain and pleasant to travel, for earnest students, with finger-posts to direct, by devising a "natural system" of animal classification. We make use of their labours while studying the economics of the animal

kingdom. Taking the Classes, Orders, Genera, and Species, our pursuit proves of boundless interest. We see the structureless sarcode, the first evolution of a cell, the earliest and simplest life-form, without organisation, yet possessing the vital power to build an axis or polypidom, which we call a sponge. The sponge dies and petrifies, and we behold a flint, the basis of pottery and glass, while of scarcely less utility as "metal" for our highways.

Some of these mites of jelly are furnished with frustules, tests, sheaths, or shells, which, as the tenants die, descend in an invisible shower to the bottom of the ocean, constituting a white soft ooze, mud, sediment, or sea-bed. Such minute tests are beset with a multitude of holes or "foramina"—hence their names *foraminifera*—and through these foramina threads of sarcose issue, as "organs of prehension" for obtaining food. The glaze scraped from a lady's card reveals, under the microscope, perfect sheaths, with markings so delicate, symmetrical, and graceful that they have been taken as successful designs for our printed cotton-cloths.

A stage forward, we light upon the Polyps proper: those "mineral blossoms with animal functions" which appear to belong to the three kingdoms of nature, to the perplexity of classification. Their fossil relics, perpetuated in our coral limestones, furnish in the rocks and mountain masses building materials in abundance. *Anemones* of this group, in the floral loveliness of our aquariums, are good for food, having the succulence and flavour of the lobster. Sea Urchins or hedgehogs (*echinus*), give a roe which was dainty fare with Roman epicures, and is still eaten along the Mediterranean. In the waters of this sea are the "fisheries" for those "barked" corals whose dense, silicious, coloured axes support a gelatinous or fleshy polyp-home for the little workers.

If in these, the humblest examples from the realms of animal life, economic uses and values are found, much more shall we meet in the higher classes subservience to human requirements. Every division of the great *Annulose* Class provides some serviceable commodity. We may barely refer to the succulent flesh of the *Crustacea;* the lustrous softness of the silkworm's web, rendered still more attractive by the pigments of the kermes, lac, cochineal, and other scale insects; the double tribute of wax and honey from the bee; the medical value of the blister-fly (Cantharides), as also of the leech. We may add to these the service to husbandry from the indirect tillage of the common earthworm, which Darwin states to be of greater effect than that of all the coral reef builders combined on the transformations of the earth's crust.

In a sense repugnant to cultivated tastes, insects regarded as noxious or loathsome possess economic uses. Locusts, whose dense clouds darken the sky, and on the soil destroy every germ of herbage, are, in turn, gathered by bushels, strung on strings, and sold in the markets of the East.

Rising to the Molluscs, one reaches a region of such direct and definite utility that we forego general description to dwell upon details, and, in a progressive degree, through the entire sub-kingdom of the Vertebrates.

## Zoological Classification.

Recent naturalists have modified Zoological classification. Research has proved the divergent groups of birds and reptiles to be structurally allied. Unlike in habits, powers, and appearance, so many affinities and transitional forms exist that the two sections are now included in one primary Class of *Sauropsida.*

In the Invertebrate division the term *Radiata* or *Zoophyta* has been abandoned. Science has determined

the accurate place of the Orders, some among the Protozoa, others with the Annulosa, a few with the Mollusca, the mass being left to form a new Class of *Cœlenterata*, distinguished by the possession of urticating or stinging cells and threads, as exemplified in the *Jelly-Fishes* or *Sea Nettles* and in the *Anemones* of our aquariums.

This precision, interesting and useful in a scientific point of view, needs not to affect the *economic* purpose of our inquiries. We may, therefore, rest satisfied with a brief reference to the facts, while availing ourselves of the older and more popular nomenclature.

I. VERTEBRATA (Latin, *verto*, I turn), or turning animals, having the central portion of the nervous system, or the brain and spinal cord, enclosed, the former in a cavity called the cranium or skull, and the latter in a canal composed of a succession of united vertebræ, or bony segments, or, as in some fishes, of cartilage.

The vertebrated animals are arranged in five classes :—

1. *Mammalia* (Latin, *mamma*, a teat). Animals which possess mammary glands and suckle their young, bringing them forth alive. Examples : the monkey, ox, seal, elephant, and whale.

2. *Aves* (Latin, *avis*, a bird). Oviparous vertebrated animals covered with feathers and organised for flight. Examples : the ostrich, swan, pheasant, and eagle.

3. *Reptilia* (Latin, *repo*, to creep). Cold-blooded vertebrated animals, covered with scales or hard bony plates, terrestrial or aquatic, air-breathing, and endowed with extraordinary powers of endurance under abstinence or against bodily injury. Examples: the turtle, snake, crocodile, and lizard.

4. *Amphibia* (Greek, *amphibios*), otherwise *Batrachia*. Fish-like in the early period of their existence, breathing exclusively by gills, and having a two-chambered heart, finally acquiring lungs and a three-chambered heart, losing

wholly or partially their piscine character, and becoming more or less terrestrial. Examples: the frog, toad, and proteus.

5. *Pisces* (Latin, *piscis*, a fish). Oviparous vertebrated animals having a branchial respiration, a covering of scales, and an organisation for life in the water. Examples: the sturgeon, cod, and herring.

II. INVERTEBRATA, animals destitute of a cranium or skull and a vertebral column.

The invertebrated animals comprise four sub-kingdoms:—

1. *Mollusca* (Latin, *mollis*, soft), or soft-bodied animals, popularly known as shell-fish. Examples: the oyster, pearl-oyster, and mussel.

2. *Annulosa* (Latin, *annulus*, a ring), or ringed animals. Examples: crabs, leeches, and insects.

3. *Cœlenterata* (Greek, *cœlos*, hollow, and *enteron*, an intestine), or hollow-intestined animals. Examples: the sea-anemone and red coral.

4. *Protozoa* (Greek, *protos*, first, and *zoon*, animal), or first animals. Example: the common sponge.

## *PRODUCTS OF THE CLASS MAMMALIA.*

This class comprises twelve orders, viz:—

1. *Bimana* (Latin, *bis*, twice, and *manus*, the hand), or two-handed animals. Example: man.

2. *Quadrumana* (Latin, *quatuor*, four), or four-handed animals. Example: the monkey.

3. *Cheiroptera* (Greek, *cheir*, the hand, and *pteron*, a wing), or hand-winged animals. Example: the bat.

4. *Insectivora* (Latin, *insecta*, insects, and *voro*, I devour), insect-eaters. Examples: the hedgehog, mole, and shrew.

5. *Carnivora* (Latin, *caro*, *carnis*, flesh), Flesh-eaters. Examples: the lion, tiger, fox, and ermine.

6. *Cetacea* (Greek, *ketos*, a whale), or whale-like animals. Examples: the whale and porpoise.

7. *Pachydermata* (Greek, *pachus*, thick, and *derma*, skin), or thick-skinned animals. Examples: the elephant, horse, and pig.

8. *Ruminantia* (Latin, *ruminare*, to ruminate), ruminating animals. Examples: the stag, ox, and sheep.

9. *Edentata* (Latin, *edentatus*, without teeth), toothless animals. Examples: the sloth and armadillo.

10. *Rodentia* (Latin, *rodere*, to gnaw), gnawing animals. Examples: the squirrel, rat, rabbit, and hare.

11. *Marsupialia* (Latin, *marsupium*, a pouch), or pouched animals. Examples: the kangaroo, opossum.

12. *Monotremata* (signifying with one orifice or outlet), beaked, non-placental mammals. Examples: the mountain porcupine (*echidna*) and duck-mole of Australia.

The mammalia, living or dead, supply us with food in the forms of flesh and milk; also with fur, wool, skins, hides, horns, hair, hoofs, fats, oils, bone, and ivory. In the horse and other quadrupeds every part is available. Leather is made from the skin; the hair is manufactured into hair-cloth and bags for crushing seed in oil-mills; the flesh furnishes food for dogs, poultry, and even men; the intestines, a covering for sausages; glue and gelatine are formed from the tendons; knife-handles and phosphorus from the bones; and buttons and snuff-boxes from the hoofs.

## I.—FURS.

We derive furs from all the orders of the mammalia, with but three marked exceptions. Man and the whales are the only nude or smooth-skinned animals. Carnivora and Rodentia principally supply the market with furs. All our furs, both home and foreign, are either felted or dressed. Felted furs are used in the manufacture of hats; dressed

furs as garments and robes. Fur is one of the most perfect non-conductors of heat, and if properly prepared, makes the most comfortable clothing that can be worn in cold climates. We find the animals there provided by Nature with fur for their own protection, and man has adopted it as the most suitable clothing for himself. Before being "worked" or prepared, the skins are called *peltry*.

The hunter strips off the skin, and hangs it up to dry, either in the open air or in a warm room. If the skin is well dried and properly packed, it may be sent to any distance in good condition; but if any moisture is left in the skin, or if it becomes exposed to damp on the voyage, putrefaction ensues, the hair falls off, and it is unfit for use by the furrier. A minute examination of the skins received is the first thing done; the grease is removed by steeping them in a liquid containing bran, alum, and salt, and by washing and scouring them; and the oil is extracted from the fur with soap and soda. By subsequent treatment, each skin is "worked" and converted into thin leather. It is now washed in clean water and dried, and is ready to be made up into articles of dress.

Felting is a process by which the different kinds of hair and wool are interlaced or intertwined, so as to form a close compact texture or mat. The felting capabilities of fur depend on the peculiar structure of the hair. Hair capable of felting has its surface covered with serratures, which may be seen with the microscope; and the felting consists in simply entangling these serratures and matting the hairs together. Hair which is devoid of this barbed structure will not felt.

Felting furs are confined to few animals, such as the hare, rabbit, beaver, and the nutria or coypu rat, which have two kinds of hair: a long and coarse kind, forming their visible external covering, which does *not* felt; and a shorter, finer,

and more abundant kind, called the fur, which lies close to the skin, and felts easily. When the skins are intended to be felted, these long hairs are removed, either by being plucked out or by very careful shearing. In the case of the beaver and rabbit, the long hair is pulled out with a short knife, the thumb of the operator being protected by a leather shield. The long hairs, of no use to the hatter, are sold for stuffing chairs. The fur used to be cut from the skin in a light fleecy mass, and the flocks were tossed about by the strokes of a vibrating string or bow, until matted together into a thin sheet of soft spongy felt; a second sheet was pressed upon it, and then a third, until the required degree of strength and thickness of felt was obtained. Felting is now much more rapidly accomplished by the felting and forming machine. The following are the most important of the fur-bearing animals:—

### Quadrumana.

The chief monkey-furs are those obtained from the *howlers*, the largest of the New World monkeys. They are made up into muffs.

### Carnivora.

Next to the monkeys, the Carnivora are the most closely allied to man in organisation. Naturalists have divided them according to their mode of progression, which depends on certain peculiarities in the structure of their feet, into three leading groups:—

1. The *Digitigradæ*, or finger-walkers (Latin, *digitus*, a finger, and *gradior*, I walk), from their habit of walking on their toes. Examples: the lion, tiger, and cat.

2. *Plantigradæ*, or sole-walkers (Latin, *planta*, the sole of the foot), because applying the whole or the greater part of the sole to the ground when walking. Examples: the bear, raccoon, wolverine, and badger.

3. *Pinnigradæ*, or fin-walkers (Latin, *pinna*, a fin or feather), having their feet well adapted for progression through the water, by an expansion of the skin or web between the digits, and also for some slight degree of progression on land. Examples: the seal and walrus.

1. *Digitigradæ.*

This division of the Carnivora includes the Family FELIDÆ (Latin, *felis*, a cat), so named by Linnæus, because an excellent example is furnished in the common domestic cat. These are characterised by the strong, sharp, retractile talons with which all their toes are armed; with teeth to correspond, peculiarly adapted for destroying other animals, and for tearing, dividing, and crushing flesh. Their sight is keen, their muscles strong and supple, and they have great power of dissembling, so as to be able to lure their victims to destruction. Fortunately for mankind these formidable creatures have not the instinct of sociality; otherwise what could withstand a troop of lions or tigers hunting in concert like wolves? The most celebrated species of this genus is—

THE LION (*Felis leo*).—This magnificent animal is distributed over the African continent and the southern parts of Asia. The long flowing mane of the male gives him a majestic appearance. His courage and strength are both indisputable, but he is as genuine a cat as the tiger, and quite as bloodthirsty and cruel in his disposition. About one hundred lion skins are annually imported into this country, chiefly from Africa.

THE TIGER (*Felis tigris*) inhabits the Asiatic continent, and is especially abundant in Hindostan. Nocturnal in his habits, lying during the day in some shady spot gorged with his last meal into sleepy indolence, the tiger frequents the neighbourhood of springs and the banks of rivers where

the weaker animals, forced by the scorching heats of the tropics, seek coolness and drink. The skin is a bright tawny yellow, shaded into pure white beneath the body, and beautifully marked with dark bands and stripes. It is used to cover the seats of justice in China, and is also employed for rugs and mats. From 200 to 250 tiger skins are annually imported into the United Kingdom.

The Leopard (*Felis leopardus*, Cuv.)—This animal is found in Africa and India; inhabits the deepest recesses of the forest, rendering pursuit nearly impossible. Taken usually in traps, it is also hunted with dogs until, being an expert climber, it takes refuge in a tree, and when the hunters come up it is easily shot. The skin is a tawny yellow, the lower parts white, and covered all over with dark spots, which vary in size and form. It is worn as a mantle by the Hungarian nobles who form the royal body-guard of Austria; also as a saddle-cloth in some of our cavalry regiments, being a mark of rank amongst the officers. Leopard skins in number about the same as those of the tiger are sent to the English market.

The Jaguar, or American Panther (*Felis onca*, L.)—A native of the warm parts of America, especially Paraguay and the Brazils. Next to the tiger, the strongest species of the genus; also an expert climber. The skin is beautifully marked with deep chocolate-brown spots upon a rich yellowish ground. Several hundred of the skins of this animal are annually imported, and used as rugs, or for ornamental purposes.

The Puma, or American Lion (*Felis concolor*, L.)—Distributed throughout the Southern American continent; found also in the warmer parts of North America. More frequently met with in grassy plains and marshy meadow-lands bordering rivers than in the forest. The puma lives upon deer, hogs, and sheep, to which it is very destructive;

for, not satisfied with the simple seizure, it will kill as many as possible, sucking only a portion of the blood. The fur of the puma is thick, close, and reddish-brown in colour, changing on the belly to a pale reddish-white. The skin is used for carriage wrappers.

THE CANADIAN LYNX (*Felis Canadensis*, Geoffroy).—A timid creature, common in the wooded districts of Canada as far north as 66°, incapable of attacking the larger quadrupeds, but well armed for the capture of the American hare, on which it principally feeds. It makes a poor fight when attacked by the hunter, spits, and sets up its hair like an angry cat, but is easily destroyed by a blow on the back. Lynx skins amounting to many thousands in number are annually sent over to this country by the Hudson's Bay Company.

THE COMMON CAT (*Felis domesticus*, L.)—In Holland the cat is bred for its fur, being fed on fish, and carefully tended until it arrives at perfection. We import annually 20,000 cat skins, and the English fur-market also receives a considerable quantity from home. The cat's skin makes an excellent rubber for electrical machinery, and is also used for sleigh coverings and railway rugs.

The Family CANIDÆ (Latin, *canis*, a dog) includes dogs, wolves, and foxes. The different varieties of dog are supposed by some naturalists to have been derived from the wolf. The common dog (*Canis familiaris*, L.) is distinguished from the wolf and jackal by its recurved tail; but the species vary in size, form, and the colour and quality of hair. In collections of fur, a few dog skins will be found, although there is no regular trade in them.

THE WOLF (*Canis lupus*, L.) once indigenous to this country, but now exterminated, still lingers in the forests of Northern and Southern Europe, and is particularly abundant in Russia, North America, and the northern

parts of Asia. Thousands of wolf skins are brought to England yearly from Europe, the United States, and British North America. They are serviceable for the linings of coats and cloaks, for sleigh coverings, and wherever additional warmth is desirable.

THE RED FOX (*Vulpes fulvus*).—It is not the common European fox, but different varieties of the American (equally well known for its cunning and mischievous attacks on the poultry yard), that is found in the furriers' shops of this country. The fox is easily distinguished by its long sharp nose and bushy tail. Foxes have been formed by zoologists into a distinct group amongst the Canidæ, or dogs, on the ground that the pupil of their eye is vertical, whilst in the dog it is circular. The tail of the fox is longer and more bushy, its head broader and more pointed in the muzzle, and its gait and attitude crouching. The red fox of America is ferruginous in colour, and strongly resembles the fox of Europe. Numerous skins are annually imported into England, most of them to be re-exported, chiefly into the markets of Turkey.

THE CROSS FOX (*Vulpes decussatus*).—This is probably only a variety of the red fox. It is distinguished by a black cross on the neck and shoulders, and is a South-American animal. Its skin is valuable, selling for several pounds sterling.

THE ARCTIC FOX (*Vulpes lagopus*).—An animal very common within the Arctic circle, which exhibits in a remarkable manner that mutation of colour which polar animals undergo with the change of the seasons. In winter it is a pure white; in summer a dorsal line of a darker colour is observable, with transverse stripes upon the shoulders. This circumstance has led to its being mistaken for the cross fox. Late in autumn these animals collect in vast numbers on the shores of Hudson's Bay, and migrate south-

ward, returning early in the following spring along the sea-coast to the northward. The southern limit of their migrations in North America is 50° north latitude. The Arctic fox is very cleanly in its habits, very unsuspicious, and easily snared. There is a dark variety known as the sooty or blue fox (*Vulpes fuliginosus*). Both the blue and the white skins are imported, but they do not fetch so high a price in the English market as the skins of the red fox.

THE BLACK OR SILVER FOX (*Vulpes argentatus*).—This species is distinguished from the others by its intensely black fur, which is intermingled with white silvery hairs, and has a white spot at the end of the tail. It is a native of the northern parts of the American continent. "An unusually fine skin of one of these animals has been sold in London for £100. The imperial pelisse of the Emperor of Russia, made of the black necks of the silver fox (exhibited at Hyde Park in 1851) was valued at £3500."

THE COSSACK FOX (*Vulpes Cossac*).—This fox inhabits the vast plains of Tartary. Its skin, which is of a clear ferruginous-yellow colour, is much prized in Russia and Turkey. More skins of these animals are taken and sold than of any other variety of the foxes.

The Family MUSTELIDÆ (Latin, *mustela*, a weasel) forms the last group of Digitigrade Carnivora whose skins supply our fur markets. This family includes the sable, polecat weasel, otter, and wolverine. These animals, from their sinuous appearance and habits, have been called vermiform quadrupeds. They are distinguished by the length and slenderness of their bodies, which enable them to wind like worms into very small openings and crevices, whither they easily follow the smaller mammalia and birds on which they prey. Several of them, as the polecat, emit a very offensive odour; nevertheless, they yield the most costly and highly prized furs.

THE ERMINE (*Mustela erminea*), the most interesting species of the weasel family, resembles the common English weasel, and inhabits Siberia, Russia, Norway, and Sweden. In winter it is clothed with a fur as white as the snow, and is invisible to its enemies; in summer its garb changes to a dingy brown.

The white fur of the ermine is highly esteemed. It is the royal fur of England and of the sovereigns and emperors of Europe. The Pope and his cardinals have their ecclesiastical robes adorned with capes and trimmings of ermine, according to their rank. The tail alone of the ermine is jet black, and this is inserted at intervals into the prepared furs as an ornament.

"In the reign of Edward III. it was forbidden to all but the royal family, and a similar prohibition still exists in Austria. There is, however, a characteristic distinction made in the mode of ornamenting the fur employed on state occasions, according as it is worn by the sovereign, or by peers, peeresses, or judges. The sovereign and royal family can alone wear ermine trimmings in which the fur is spotted all over with black—a spot in about every square inch of the fur. These spots are not formed of the tail of the ermine, but of the paws of the black Astracan lamb. The crown is also adorned with a band of ermine with a single row of spots. Peeresses wear capes of ermine, in which the spots are arranged in rows, the number of rows denoting their degrees of rank. Peers wear robes of scarlet cloth, trimmed with pure white ermine without any spots. But the number of rows, or bars of pure ermine, in this case also denotes the rank. The robes of judges are also scarlet and pure white ermine." *

The number of ermine skins annually imported is enor-

* "Cyclopædia of Useful Arts." By Charles Tomlinson. Vol. i. p. 729.

mous, and of these very few are re-exported. The fur of the ermine is manufactured into ladies' muffs, tippets, trimmings, and linings.

The Russian Sable (*Mustela Zibellina*).—This is the next fur to ermine in value and in general use. The animal which yields it lives in the wilds of Siberia, and is hunted in the depths of winter, when its fur is most valuable. The fur is brown, with some grey spots on the head. The darkest in colour are considered to be the best. The skins are small, but they are sold at prices varying from three to ten guineas. Comparatively few of these valuable furs are received in England, because so much prized in Russia, where tens of thousands are annually collected.

This fur is manufactured into linings, sometimes valued as high as 1000 guineas. The Lord Mayor, aldermen, and sheriffs of the city of London have their robes and gowns lined with Russian sable, according to their respective ranks. The tails of sables are used for artists' pencils and brushes.

The Minx (*Mustela vison*).—The minx is a native of North America, and its skin comes to us principally through the Hudson's Bay Company. In the month of March this Company holds annually, in London, a public fur sale, which attracts great numbers of foreigners. Through them, the furs destined for the Continent find their way to Leipsic, whence they are distributed throughout Europe. The fur of the minx resembles the sable in colour, but is shorter and more glossy. It is much used for ladies' wear, and is made into victorines, cloaks, and muffs. In a single year, the number of skins of this little animal received in this country have amounted to a quarter of a million. Their price varies from ten to fifteen shillings a-piece. When this skin is of a silver-grey colour it is additionally valuable. A muff made of six of such skins has an average worth of twenty-five guineas.

The American Sable (*Mustela leucopus*).—The fur of this sable varies from a tawny colour to a deep black. The animal itself is known by its white feet. The fur, much worn in England, is made into cuffs, muffs, and boas. As many skins of the *marten*, which is of the sable species, are imported as of the minx.

The Polecat (*Mustela putorius*).—Common throughout Europe. Very destructive in the poultry yard, and very courageous. Its flexibility is so great, that when not griped in the right place by a terrier it will turn and fasten on the dog. This animal has a soft black fur, with a rich yellow ground. The odour of the fur is unpleasant, but processes have been adopted which effect its removal. The finest of these skins are obtained in Scotland. They are trapped, in numbers to equal the captured minx and marten, in order to supply the London fur market. About a tenth of the produce is exported to America, where the fur is much sought after.

The Pine Marten (*Mustela Abietum*, Ray).—Found abundantly in the forests of Northern Europe and America. It shuns the habitations of man, and preys on birds and the smaller animals—mice and hares. When its retreat is cut off it shows its teeth, sets up its hair, arches its back, and hisses like a cat. About half as many pine marten skins as the polecat supplies are annually imported into England from the territories of the Dominion of Canada.

The Beech Marten (*Mustela Foina*).—A fur yielder with a white throat, and is thus distinguished from the pine marten, the throat of which is yellow. It is found in woods and forests in Northern Europe, but nearer the habitations of man than the pine marten. It is imported in considerable quantities from the north of Europe, and is dyed to imitate sable.

The Stone Marten (*Mustela saxorum*).—A variety of

the marten distributed throughout Europe. Its under fur is bluish white, with the top hairs a dark brown; its throat a pure white, by which it is generally distinguished. The French excel in the art of dyeing this fur, which is frequently sold under the name of French sable.

THE TARTAR SABLE (*Mustela Siberica*).—A little animal caught in the northern parts of Russia and Siberia. The fur is bright yellow, the colour being uniform all over the body. The skin is used both in its natural state and dyed; the tail is employed for artists' pencils.

THE WOODSHOCK, or PEKAN (*Mustela Canadensis*).—The pekan inhabits North America, and is also called Hudson's Bay sable. As the colour of this skin is much lighter than the prevailing taste, it is dyed of a darker hue. Thus treated, it is scarcely inferior to the Russian sable, which it is intended to imitate.

THE SKUNK (*Mephitis Americana*) is common in North America, especially in the States of Pennsylvania and New Jersey. It is well known for its power of ejecting, when hunted, from a small bag placed at the root of the tail, a very offensive fluid, which produces one of the most powerful and intolerable stenches in nature. This animal is allied to the polecat of Europe. Its fur is soft and black, with two white stripes running from head to tail. The fur is purified by exposure to heat. Most of the skins brought to Europe are re-exported.

THE AMERICAN OTTER (*Lutra Canadensis*) is aquatic in its habits, and lives principally upon fish, which it pursues in the water. The colour of the fur changes with the seasons; in summer it is short and almost black, but on the approach of winter it alters to a beautiful reddish brown. The motions of the otter in the water are very easy and graceful. The short, close, fine fur keeps the body at a proper temperature, and the short legs, webbed feet, and rudder-like

tail enable it to move swiftly in any direction in pursuit of its agile prey. Otter skins of this variety are valuable even before "worked" by the furrier, when they belong to the class of costly furs.

THE SEA OTTER (*Enhydra marina*).—The fur of the sea otter is thick, soft, and woolly, and much prized in Russia and China, where it is the fur of royalty; to those countries most of the skins are exported. The animal is found in the North Pacific, from Kamtschatka to the Yellow Sea, on the Asiatic coast, and from Alaska to California, on the American coast. It is a rare animal, and not more than 1000 skins are annually procured. They are classed with the costliest, being worth, at first hand, in the market, over ten pounds sterling. The sea otter haunts sea-washed rocks, lives mostly in the water, and approximates to the seal in its habits. Its fur is generally employed for collars, cuffs, and trimmings. It is very beautiful, of a deep velvety maroon brown, the anterior parts being of a silvery grey. The finest sea-otter skins exceed forty pounds in value, and a muff made therefrom costs about twenty-five guineas.

### 2. *Plantigradæ.*

This group includes the Family of the URSIDÆ, or bears—heavy, stout-bodied animals, with thick limbs and a very stout tail—which inhabit the wooded and mountain districts of the arctic, temperate, and sub-temperate regions of the northern hemisphere.

BLACK BEAR (*Ursus Americanus*), the skin of which is imported generally from British North America, and chiefly for military accoutrements. It is made into caps, rugs, and pistol holsters.

The skins of the polar bear (*Thalassarctos maritimus*),

the brown bear (*Ursus arctos*), and the grisly bear (*Ursus ferox*) are also imported.

THE RACCOON (*Procyon Lotor*).—Indigenous to North America; frequents the sea-shore and the margins of rivers and swamps, where it lives upon small animals, birds, insects, and mollusca, with the addition of roots and succulent vegetables. Three-quarter millions of raccoon skins are occasionally imported into the United Kingdom. Two-thirds of this number were re-exported, principally to Germany, where they are used for making hats. The hair of the upper part and sides of the body is of uniform length and colour, and is employed for the linings of coats and rugs.

THE BADGER (*Meles vulgaris*, Desmarest) is found throughout the northern parts of Europe, Asia, and America. Its habits are nocturnal, inoffensive, and slothful. Its feet are plantigrade, and its long claws enable it to burrow in the woods. The badger feeds on roots, earth-nuts, fruits, insects, frogs, and the eggs of birds. Its muscular strength is great, and its bite powerful. The American badger (*M. Labradoricus*) is larger than the European species. The long hairs are employed for making shaving brushes and painters' pencils. In Europe, badgers are hunted with dogs; in America, they are caught in early spring, whilst the ground is frozen, by pouring water into their holes.

THE GLUTTON OR WOLVERINE (*Gulo luscus*) inhabits the northern parts of the American continent. Wolverines feed chiefly upon the carcasses of beasts which have been killed by accident. They are very troublesome to the Hudson's Bay trappers, for they will follow the marten-hunters' path round a line of traps extending from forty to sixty miles, and render the whole unserviceable, by removing the baits, which are generally the heads of partridges or

bits of dried venison. They resemble the bear in their gait, and feed well; they are generally, when caught, found to be very fat. The fur is a fine deep chestnut colour, with a dark disc on the back. The fur of the wolverine is much esteemed in Germany and Russia, and used for cloak linings, muffs, and sleigh robes.

### 3. *Pinnigradæ.*

This group includes the family *Phocidæ* (Latin *phoca*, a seal), and comprises the seals, sea-bears, and walruses, which are found chiefly in the arctic and antarctic seas, and are of great value alike for their oil, bones, and skins. The chief hunting grounds are the fields of pack ice in the Greenland seas, and around the shores of Spitzbergen.

THE SADDLEBACK OR HARP SEAL (*Calocephalus Grœnlandicus*).—This species, which is the most important of the *Phocidæ* in commerce, is at all times gregarious, but never seen to assemble in such numbers as during the months of March and April, when it takes to the ice to bring forth its young. During those months a pack of ice three miles in diameter has been calculated to have no fewer than four millions of seals upon it. Its length does not exceed eight feet. The name saddleback is given to it from an aggregation of black well-defined spots scattered over a yellowish-white ground in the form of a saddle or harp.

For the capture of this seal, especially during the breeding season, many ships are annually sent out, and the number taken yearly amounts to hundreds of thousands. The success of the sealers varies: a ship one year may obtain as many as 20,000 seals, and next year not capture a hundred. The chief art of sealing lies in finding out where the main body of seals is located; a sort of instinct directs these animals in flocks to a common centre, where they remain till the young are capable of taking to the water.

The harp seal is highly prized. From its blubber the Greenlander and Esquimaux procure light and heat; they cover their boats and bodies with its skin, make thongs with its entrails, a *derg* or float with its stomach, and fashion the teeth into tips for their arrows and harpoons.

The Bladder-nose Seal (*Stemmatopus cristatus*) inhabits the Greenland seas, and is found in small groups of three or four. On account of the beauty of its fur and the immense amount of its blubber it is much sought after. It differs from the other species in having a thick black—in the young, delicate brown—woolly coat, which lies beneath its outside bristly hair.

The Common Seal (*Phoca vitulina*, L.) is found on the coasts of Scotland, France, and other parts of Europe. The usual haunt is a hollow or cavern in a rock near the sea, and above high-water mark. They are extremely watchful, seldom sleep more than a minute, raise their heads, and if nothing is to be seen or heard, lie down again; but if disturbed, they instantly tumble off the rocks into the sea. They are usually shot when asleep. If surprised by the hunter at a distance from the shore, they hasten to the water, flinging stones and dirt behind as they scramble along, and expressing their fears by piteous moans. When overtaken, they make a vigorous defence with their feet and teeth until killed.

We import from Greenland, British North America, and the United States, as well as from Norway, Russia, and other parts of Europe, millions of undressed skins. The slaughter of the seals has been so ruthless as to rouse fears of the extermination of the race.

The skin of the seal, when tanned, is employed in the making of shoes; and when dressed by the furrier, serves for the covering of trunks, and for articles of clothing, such as caps and hats, mantles and muffs, coats and boots.

## RODENTIA.

The *Rodentia* (Latin, *rodo*, I gnaw), or gnawing mammalia, are, for the most part, of small size, but numerous and prolific. They are distributed all over the world, even in Australia, which possesses some few indigenous species. They have two pairs of curved cutting or incisor teeth, which project from the front of each jaw, and from two to six molars on each side, but they are devoid of canine teeth. The rodents of the greatest value in the fur market are :—

THE BEAVER (*Castor fiber*, L.)—This animal is found in Canada, where it frequents the banks of rivers and marshes, making large dams with the stems of trees plastered with mud to keep out the water, and building rude dwellings in the water, with engineering skill and ingenuity. The fur of the beaver consists of two kinds of hair, one long and rigid, forming the outer coat, the other soft and downy; the latter is employed for coat linings, muffs, and other articles of dress.

THE MUSK RAT, or MUSQUASH (*Fiber zibethicus*), is much smaller than the beaver, which it resembles in its fur and habits, and with which it associates. Above a million are annually taken by the Canadian trappers, and their skins sent over to the fur markets of this country. Dressed in the same way as beaver skin, they form a cheap durable fur for ladies' wear.

THE NUTRIA, or COYPU RAT (*Myopotamus Coypus*), inhabits South America, living near streams, and burrowing in their banks. It is smaller than the beaver, and also differs in the possession of a round hairy tail. Its skin forms a good substitute for that of the beaver, and is dressed in a similar manner. Many millions of nutria skins have been imported from South America into the United Kingdom; and this number tends to increase, the fur being so well

suited for felting that it is the chief material employed in the manufacture of the favourite "wideawake" or "billycap."

THE SQUIRREL (*Sciurus vulgaris*, L.)—Light, nimble, and graceful animals, living on the branches of trees, feeding on nuts and other hard fruits, which they gnaw through with their sharp front teeth, carefully removing every particle of skin from the kernel before eating it. Squirrels are distributed through all parts of the world except Australia, but are especially abundant in North America. Their skins are used for ladies' and children's wear, and millions are sent to our fur markets under the name of *Calabar.* The fur is sometimes dyed to imitate sable. The tail is used in the manufacture of boas and artists' pencils. Besides the common squirrel, the grey, black, and American red squirrel yield useful and ornamental furs.

THE CHINCHILLA (*Chinchilla lanigera*).—An elegant, active little creature, inhabiting the Andes of South America, in Chili and Peru, and living at a considerable altitude. The posterior legs are longer than the anterior, and the animal when feeding sits upon its haunches, holding its food between its short fore-paws. The ears are large and broad. The fur, thick, soft, and of a greyish colour, reaches us through the South-American markets. Chinchilla fur is admired for winter clothing, and is made into muffs, mantles, boas, cloak linings, and trimmings for ladies' and children's wear.

THE HARE (*Lepus timidus*) and RABBIT (*Lepus cuniculus*). —Rabbits were in ancient days special to Spain, brought there from Africa by the Iberians, from whom the Romans acquired their knowledge of the animal, and whence it has spread over Europe. The skin of the rabbit is made into all sorts of cheap and warm winter clothing; that of the hare is frequently worn over the chest as a protection against external cold. We have supplies of rabbit skins

sent to our markets from the rabbit warrens of Norfolk, the Orkney and Shetland Islands, and Ostend. Incredible numbers of rabbits are sold yearly in London, and hare skins are annually imported into this country from Russia, Germany, Denmark, Friesland, Poland, Wallachia, Turkey, Greece, and Sicily. The best and the greatest number come from Russia.

### RUMINANTIA.

The animals of this order are distinguished from the other mammalia by the facilities which they possess for ruminating, or chewing their food twice over. In the majority the lower jaw alone is furnished with incisor teeth, their place in the upper jaw being occupied by the hardened gum. The molars are separated from the incisors by a considerable gap in the jaw. Examples: sheep and deer.

THE AMERICAN BUFFALO, or BISON (*Bison Americanus*, L.)—Vast herds of buffaloes roam over the western prairies of North America, and hundreds of thousands of them are annually killed. Buffalo robes are much esteemed in America as sleigh coverings. They are made up and sold in New York, but the number is reducing from the wanton and near extinction of this fine animal. During the Crimean war our soldiers found these robes of great service; about 20,000 buffalo robes were furnished by the English Government.

The skin of the LAMB is made into collars, muffs, gloves, and coat linings. The most valued of these skins are furnished by Southern Russia, Greece, and Hungary. Beautiful black lamb skins are imported from the Crimea, and others still more rich and glossy, with a short fur, from Astracan. The lamb skins from Persia are known by the curl of the hair, which is produced artificially by tying up the lamb, as soon as born, in a leathern skin, and thus preventing the hair from expanding. These Persian lamb skins are used for coats and other garments.

The skin of the fœtal CALF is used for covering trunks.

The principal fur marts for the English or Canadian furs are London, in Upper Canada; Fort William, on Lake Superior; and in Lower Canada, Montreal, on the river St. Lawrence.

## II.—PERFUMES.

THE MUSK DEER (*Moschus moschiferus*, L.; order, *Ruminantia*), which furnishes the well-known perfume called musk, and must not be mistaken for the false musk deer (*tragulus*), is about the size of a roebuck, without horns, legs very slender, and in all its movements exceedingly active and graceful. The musk deer is found in herds in the mountains of Central Asia, and in some of the larger islands of the Indian Ocean, such as Ceylon, Java, Sumatra, and Borneo. It is a shy animal, fond of precipices and almost inaccessible crags, and therefore very difficult to shoot. The musk is produced in a glandular pouch in the abdomen, and is peculiar to the male. It is in the form of reddish-brown coarse granules, and greasy to the touch. The average quantity which can be removed from one pouch is about 190 grains.

Musk is known in commerce under two forms—as Tonquin or Thibet musk, which is the most valuable, and Siberian, Kabardinian, or Russian musk, of inferior quality. The Oriental or Tonquin musk from Cochin-China and Tonquin is imported in small oblong rectangular boxes, which are lined with lead, to prevent the escape of the odour; the musk bags, wrapped in thin blue or red paper covered with Chinese characters, are placed in these boxes. These musk bags, are usually covered with hairs, which all converge towards the little narrow opening in the bag. The weight of each bag varies, some not exceeding half an ounce, whilst others weigh upwards of two ounces. Large

numbers of musk deer are annually killed. The annual import of musk into the United Kingdom is upwards of ten thousand ounces.

Besides its uses as a perfume, musk also possesses valuable remedial qualities. When genuine, it is one of the most powerful of the antispasmodics, and is applied with advantage in cases of infantile spasms, when not accompanied with inflammation.

Civet Cat (*Viverra civetta*, Gm.; order, *Carnivora*).—A native of Northern Africa, and especially common in Abyssinia, allied to the polecat and marten. Body from two to three feet long, and from ten to twelve inches high; tail half as long as the body. The civet, when captured, is enclosed in a small cage, in which it cannot turn round, and while thus confined, the secretion is removed from its large anal pouch two or three times a week with a spoon or spatula. The interior of the pouch is glandular, the glands secreting the perfume from the blood of the animal. The substance itself is of a pale yellow colour, and of the consistence of honey. It is not unlike musk, and to most persons smells disagreeably, but when mixed with butter, wax, lard, and alcohol, in the proportion of one part to a thousand, it loses its offensive character, and becomes aromatic and delicately fragrant. Thus prepared it is used in perfumery, and when employed, renders more perceptible other scents with which it is mixed. Lavender and other scented waters become more agreeable by the addition of minute quantities of civet. The substance is not so much in use now as formerly; nevertheless, there is still a considerable consumption of it in this country, and as much as forty shillings an ounce is paid for it.

*Viverra zibetha* is another species of civet cat, peculiar to the Asiatic continent, and found from Arabia to Malabar, and in the larger islands of the Malayan Archipelago. It

is much milder in its disposition than the African species, and is domesticated by the Arabs and Malays. Our supplies of civet are also derived from this animal, although to a less extent than from the African species.

*Castoreum*, which strongly resembles musk in its medicinal qualities and applications, is furnished by the BEAVER (*Castor fiber*, L.) This substance is secreted in the interior of a little bag or pouch with which the beaver is supplied. It is brought to market, like the musk, in the pouch. The best *Castoreum* is that from Russia and Siberia; a very good quality is furnished also by Poland, Prussia, Bavaria, Germany, Sweden, and Norway; an inferior kind comes from Canada and the territories of the Hudson's Bay Company.

AMBERGRIS.—This substance is obtained from the sperm whale. It is an expensive drug, because not frequently found, and is valued on account of the excellency of its fragrance. Ambergris is a morbid or diseased concretion formed in the stomach, or probably in the gall-ducts, of the sperm whale, in masses of considerable size, sometimes weighing thirty or forty pounds. It is usually found floating on the surface of the water, probably disengaged from the floating body of one of these monsters, and is rarely sought for in the intestines of the sperm whale, although it is worth a guinea an ounce. It is fished up in the Indian Ocean, near the Moluccas and Philippine Islands; also near Sumatra, Madagascar, and on the coast of Coromandel. In the Atlantic Ocean it is found near the West Indies and the Brazils. Ambergris is used as a costly frankincense, especially in France. It has also the property of increasing the power of other perfumes, and is used mainly for this purpose.

## III.—STEARINE AND OILS.

The chief supply of animal oil is derived from various species of seals (order *Carnivora*, family *Phocidæ*) and whales (order *Cetacea*).

In order to meet the needs of the creature it defends, the true skin of whales is modified, forming the layer of blubber called by whalers the blanket, probably in allusion to its office of preserving the animal heat. The blubber is composed of a number of interlacing fibres, capable of containing a very large quantity of oily matter. The thickness of the blubber varies in the several species; those inhabiting the frigid zones have it of greater thickness than those which habitually live in warmer seas. It is never less than several inches, and in many parts of a whale is two feet deep, and, moreover, as elastic as caoutchouc, offering an admirable buffer to the force of the waves and the pressure of the water, as well as a defence from cold. In a large whale the blubber will weigh thirty tons.

The species of whales regularly hunted for the sake of their oil are:—

THE GREENLAND WHALE (*Balæna mysticetus*).—Confined to the Greenland and Spitzbergen seas, its migrations being regulated by the extent of the perpetual ice.

THE HUMP-BACKED WHALE (*Megáptera longímana*) attains a length of sixty to seventy feet, and inhabits the Greenland seas, where it is found in great abundance. Its oil is said to be superior to that which is furnished by the Greenland whale, and not much inferior to the oil of the sperm whale.

THE PIKE, or FINNED WHALE (*Balænoptera rostrata*) is a native of the seas that wash the shores of Greenland, and is sometimes seen near Iceland and Norway. The flesh is in some repute as a delicacy among the natives of these

northern regions. The oil which it furnishes is particularly delicate.

Sperm Whale (*Cátodon macrocéphalus*).—This species measures from seventy to eighty feet in length, and is chiefly notable on account of the valuable substances which are obtained from its body—oil, spermaceti, teeth, ambergris. It differs from the true whales in having no baleen plates in the palate, but from forty to fifty conical teeth in the lower jaw, which fit into cavities in the upper, so that the mouth is capable of being completely closed. The head is of an enormous size, forming about one-third of the entire length of the animal. It is cylindrical, truncated, composed of a sort of cartilaginous envelope, containing an oily fluid, which hardens by exposure to the air, and is then known as *spermaceti*. This substance is also diffused through the blubber.

The sperm whale, or cachelot, is generally distributed in all seas, but principally in those of the southern hemisphere.

The oil is obtained from the blubber, which is only fourteen inches in depth on the breast, and eleven inches on the other parts of the body, and is therefore not so abundant in proportion to the size of the animal as that which is extracted from the Greenland whale. Its superior quality, however, compensates fully for its deficiency in quantity. It is much used for burning in lamps.

The spermaceti from the head is very valuable as an ointment, and for the manufacture of candles. The United States fit out more ships than any other nation for this whale fishery, bringing home vast quanities of train oil, with about three-fourths of the number of casks of spermaceti. Next to the United States, England is the country most engaged in the whale fisheries. France employs a good many ships in this business, the principal port being Havre. Norway, Sweden, Denmark, and the Hanseatic Towns take

some part in the whale fisheries. A flourishing Southern whale fishery has sprung up in Tasmania.

Spermaceti candles are mostly manufactured in England, the raw material being in a great measure imported from the United States.

THE BELUGA (*Beluga cátodon*), also called the White Whale on account of the colour of its skin, is an inhabitant of the higher latitudes, being found in great numbers in Hudson's Bay and Davis's Straits, and frequenting the mouths of large rivers on the northern coasts of Asia and America. The oil furnished by the Beluga is sufficiently valuable to have led to the establishment of regular Beluga hunts in the great North American rivers, which they ascend for some distance in search of prey. The skin can be made into a peculiarly strong tough leather, and is said to resist an ordinary musket-ball.

THE SEALS, described in pp. 308–9, are hunted for the sake of their oil; and the pursuit of them is superseding that of the Greenland whale, for the latter has been greatly reduced in numbers by whalers for upwards of one hundred years.

A large number of British vessels are engaged each year in the capture of whales and seals; and the importation of train or blubber oil from British North America reaches many thousand tuns per annum.

TALLOW is animal fat of great commercial value, separated from membranous matter by fusion, and consists chiefly of stearin, with a small quantity of olein. It is manufactured into candles and soap, and is extensively used in dressing leather, and in various other processes in the arts. We are supplied extensively with native tallow, and we import a large quantity, principally from Russia, Hungary, and Turkey. Our imports of tallow from Australia and the Argentine Confederation show increasingly large averages.

The entire imports from all parts take a high place among the figures of British commerce.

The tallow we receive from Australia is chiefly obtained from sheep, the carcases of which used to be boiled down for this product alone; that from South America is from oxen and even horses, which roam in a half wild state over the grassy plains of Monte Video and La Plata. The animals are slaughtered for their hides, tallow, and bones.

## IV.—FOOD PRODUCTS.

Butter is made in the counties of Cambridgeshire, Suffolk, Yorkshire, Somerset, Gloucestershire, Oxfordshire, and Essex. In Scotland excellent butter is made in Clydesdale and Aberdeenshire. The butter produced in Great Britain is, however, insufficient for home consumption, and large quantities are imported, principally from Ireland, where it is a staple commodity; and from Holland, Belgium, the Hanse Towns, France, and the United States. The foreign imports grow larger year by year.

Cheese is the curd of milk compressed into solid masses of different sizes and shapes, salted and dried, and sometimes coloured and flavoured. Besides our own supply of Gloucester, Cheddar, Cheshire, and Stilton cheeses, which are the most in demand, we import a considerable number of foreign cheeses, amongst which are Limburg cheese from Belgium, Swiss cheese from Switzerland, Parmesan cheeses from Parma and other places in Lombardy, Gorgonzola from Italy, American cheeses from the United States, Edam and Gouda cheeses from Holland, and German cheeses from Westphalia. The last come to market in round balls, or short cylinders, of one to three pounds in weight.

The rich flavour of Parmesan cheese is owing to the aromatic plants which abound in the Italian pastures.

Stilton cheese, so named from the town in Huntingdonshire where it was first brought into notice, is the dearest of all English cheeses, the price being generally to that of Cheshire as two to one, or two to one and a quarter. To produce premature decay, and consequently an appearance of age, in these cheeses, the manufacturers are said to bury them in masses of fermenting straw; also to spread the curd out on the ground over night, and the germs of blue mould or fungous growth ever floating in the atmosphere settle upon the rich cheese, where they find a congenial soil for their development. The quantity of cheese of all kinds imported already grows wonderfully in importance, the principal countries which supply us being Holland, United States, and the Dominion of Canada.

LARD.—The melted fat of swine is imported chiefly from the United States.

LIVE STOCK.—*Oxen.*—The statistics of our imports of live cattle and of their values vary very much. The trade is restricted by the precautions taken to prevent outbreaks of disease, the ports being occasionally closed. Despite these difficulties the trade is a large one, the principal countries whence imported being Schleswig Holstein, Holland, and Germany.

*Sheep and Lambs*, principally imported from Holland. The imports fluctuate widely, yet are of an extensive character, with a normal tendency to increase, sometimes reaching a million head, sometimes barely half the number, with corresponding fluctuations of the total yearly values.

MEATS.—*Bacon and Hams.*—The greatest supply of "provisions" (bacon and ham), as salted meats are called in trade, was from the Hanse Towns and the United States. So far as quality goes, however, no imports of these commodities excel our own Irish brands.

*Beef and Pork.*—Corned or salted provisions are largely imported from the Hanse Towns and the United States.

## *Preservation of Meat.*

How to meet the growing demand for butcher-meat, consequent on an increase of population and a relative decrease of stock, is a question of importance to the commercial prosperity of this and other countries, and calls for the attention of legislators and scientific men. Though the stock of sheep and cattle raised in England is large, and that of cattle in Ireland and Scotland is a source of wealth to those two countries, yet enormous quantities of meat are imported. When we turn our attention to Australia and the Argentine States, we find the flesh of cattle and sheep sacrificed for other parts of the animal; and he who shall devise the best method by which these meats can be economically imported into this country will be hailed as one of the greatest public benefactors. The importation of the living animals on a large scale seems out of the question, notwithstanding the arrival of one or two cargoes; and as the jerked or sun-dried beef, though brought in at low rates from Monte Video and other parts, has not found favour, there only remains the discovery of a process by which the meat can be preserved in a fresh state a sufficient length of time to admit of its transportation from distant regions.

This art of preserving meat is modern, and differs entirely from the old and common methods by means of salt, saltpetre, or sugar, which substances, when in solution, do not absorb oxygen, and therefore they prevent decomposition. The history of the art of preserving meat in a fresh state is associated with the earliest arctic explorations. Scientific observers found that scorbutic diseases arising from living exclusively on salt meat were fearfully aggravated

by extreme cold; the Admiralty, therefore, offered inducements to merchants to devise plans for preserving unsalted meat, cooked, or in a raw state, thus doing away with the use of salt meat altogether. It is hardly possible to overestimate the importance of this subject, as is evident from the fact that preserved fresh provisions, especially with vegetables, and when combined with the juice of limes or of lemons, are an absolute preventive of the sea-leprosy. Methods have also been introduced for bringing over frozen carcases in vessels engaged in the foreign meat trade, single cargoes from New Zealand exceeding 20,000 sheep. Immense quantities of excellent fish, flesh, and fowl, from the antipodes and other distant parts have thus been added to our food stores.

M. Appert, a French gentleman, was the first to succeed in the attempt to preserve unsalted or fresh meat, and in 1810 he received a prize of 12,000 francs from the Parisian Board of Arts and Manufactures. In the following year, M. Durant, a colleague of M. Appert, took out, in this country, a patent, which was subsequently purchased by Messrs. Donkin, Hall, & Gamble, for £1000.

M. Appert's process consisted in partly cooking the meat, placing it in a glass vessel in a bath of chloride of calcium, heating it to about 240° F., and then hermetically sealing the lid. Appert's plan, as adopted and improved by Messrs. Donkin, Hall, & Gamble, is as follows:—Tin canisters are substituted for the glass vessels, and the meat (previously parboiled) is placed in them, with a rich gravy or soup. The lids, which are pierced with a small hole, are then soldered down air-tight, and the canisters immersed in a bath of brine or chloride of calcium—substances which can be raised to a temperature much exceeding that of boiling water, and which can, therefore, communicate, through the whole contents of the tins, a degree of heat at least up to

212° Fahr., or that of the boiling point of water. On the steam issuing from the hole in the canister lid, it is suddenly condensed by the application of a cold wet rag, and a drop of molten solder being dexterously applied to the hole at the same moment, the case becomes hermetically sealed. On cooling, the ends of the canisters are slightly concave, from atmospheric pressure, if the process has been successful; but if the ends have flattened, or become convex instead of concave, then either the case has not been properly soldered and is not air-tight, or the meat has decomposed and liberated gases.

The defect of tinned provisions is their over-cooked taste, as a necessity of their mode of preparation. A remedy for this is found in sealing the tins first, and bringing them close, but not actually, to boiling point (or the steam then formed would burst them); when, upon being punctured, the heated air and vapour escape, and the tins are once more soldered. The newest and most perfect process of preparing the tins is that of boiling in vacuo, whereby the over-cooked effect is perfectly averted.

As soon as this modification of Appert's process was made practically perfect, it was tested by order of the Admiralty, and ships were sent by them to the arctic regions with an abundant supply of these meat canisters. The officers in command reported favourably of the whole. Their value in cold climates having thus been proved, the experiment was tried with equal success by vessels trading in the tropical regions. For ship use these preserved meats are invaluable, and hardly a vessel now leaves this country without a supply. In India they are extensively used as luxuries in the towns, and as necessaries in the remote districts, where fresh meat of any kind is scarce and bad. It may be noted here that most of the ocean steam-ships belonging to ports of the United States

and Europe are provisioned with fresh meats conserved in ice.

## V.—WOOL.

In commerce this term is applied to the hair of the alpaca, goat, beaver, and rabbit, and to allied substances; but, strictly speaking, it belongs to the sheep alone, the hair of which, from time immemorial, has been woven into cloth.

Wools are divided into two great classes—clothing wools and combing wools, or short wools and long wools; and the fabrics woven from them are termed woollens or worsteds, according as the one or the other is employed. The fibres of clothing wools felt or interlace, forming thereby a dense compact material, suitable for warm and heavy clothing, when manufactured into broad cloths, narrow cloths, felt for hats, blankets, serges, flannels, and tartans. Combing wools, on the contrary, though long in fibre, do not felt, and are therefore employed in the manufacture of light and loose, but still warm, garments—such as stuffs, bombazines, merinoes, hosiery, camlets, and shawls, and various mixed goods, as damasks, plushes, and velvets.

The wool of the sheep has been greatly improved since the animal has been brought under the fostering care of man. The *mouflon*, which is considered by some zoologists as the parent stock of the common domestic sheep, inhabits the mountains of Sardinia, Corsica, Greece, Barbary, and Asia Minor. This animal has a very short and coarse fleece, more like hair than wool. When domesticated, the rank hair disappears, and the soft wool around the hair-roots, which is hardly visible in the wild animal, becomes developed. If sheep are left to themselves on downs and moors, there is a tendency to the formation of this hair amongst the wool; its occurrence in the fleece of domestic sheep is therefore rare, and is always regarded as defective sheep-farming.

There is in the United Kingdom a great distinction of build, flesh, and wool between the mountain sheep and those of the grass lands or plains. Those of the plains, though they vary much among themselves, are yet of more uniform character, and excel the mountain sheep in every economic quality. The South Down, dark-faced, and Leicester, white-faced, are regarded as the only pure breeds; but many cross breeds prevail, chiefly from the merinoes of Spain, reared with the view of improving both flesh and wool.

The climate of this country is unfavourable to the growth of the best wools; hence the superiority of the Merino, Saxony, and Australian wools, the produce of countries having a higher average temperature. Merino wool is obtained from the migratory sheep of Spain, a breed distinguished from the British by bearing wool on the forehead and cheeks; the horns are large, ponderous, and convoluted laterally; the wool is long, soft, and twisted into silky-looking spiral ringlets, and is very superior in its fineness and felting properties. Its closeness and a luxuriant supply, from the glands of the skin, of yolk or natural oil, which serves to nourish it and mats the fibres together, renders it an excellent natural defence against the extremes of heat and cold. These migratory sheep, amounting in Spain to 10,000,000, are led twice a year (in April and October) a journey of 400 miles, passing the summer in the pastures on the slopes of the Pyrenean mountains, and the winter on the plains towards the south.

The word *merino* signifies an overseer of pasture lands, and is applied to these sheep because in Spain they travel in detachments of 10,000 each, under the care of fifty shepherds and as many dogs, with a mayoral or chief shepherd at their head, and have a general right of pasturage all over the kingdom. "Several of the sheep are tamed

and taught to obey the signals of the shepherds; these follow the leading shepherd (for there is no driving), and the rest quietly follow them. The flocks travel through the country at the rate of eighteen to twenty miles a day, but in open country, with good pasturage, more leisurely. Much damage is done to the country over which these immense flocks are passing; the free sheep-walk which the landed proprietors are forced to keep open interferes with enclosure and good husbandry; the commons, also, are so completely eaten down that the sheep of the neighbourhood are for a time half starved. The sheep know as well as the shepherds when the procession has arrived at the end of its journey. In April their migratory instinct renders them restless, and if not guided, they set forth unattended to the cooler hills. In spite of the vigilance of the shepherds, great numbers often escape; if not destroyed by the wolves, there is no danger of losing these stragglers, for they are found in their old pasture, quietly awaiting the arrival of their companions."*

This celebrated breed is now reared in Saxony and in Australia, which has become one of the principal wool-growing countries in the world. In 1464 Spain imported ewes and rams from the Cotswold hills.

The Cretan or Wallachian sheep, remarkable for magnificent formation of its horns, possesses a fleece of a soft woolly undercoat, covered by long drooping hairs. The wool is extremely fine, and is employed in the manufacture of warm cloaks, largely used by the peasantry, and so thick and warm that they defend the wearer against the bitterest cold.

The chief countries which supply us with sheep and lambs' wool are Russia, Hanse Towns, Argentine Con-

"Cyclopædia of Useful Arts and Manufactures." By Charles Tomlinson. Vol. 2, p. 1030.

federation, British Possessions, Africa, British India, and Australia. The Australian wool trade is taking vast dimensions, and outrivals the produce of gold and all other produce in yearly value.

There are other ruminant animals from which the wools of commerce are obtained besides the sheep. The following are the chief:—

ANGORA GOAT (*Capra Angorensis*, Hasselq.)—It inhabits the mountains in the vicinity of Angora, in Asia Minor. In colour it is milk-white; legs short and black, horns spirally twisted and spreading; the hair on the whole body is disposed in long, pendulous, spiral ringlets, and is highly valued in Turkey, the finest and most costly Turkish robes being manufactured from the fleece, which is as soft and fine as silk. It was first brought into the markets of Europe under the name of Mohair. Its exportation, unless in the shape of yarn, was formerly prohibited, but it is now allowed to be exported unspun. Mohair is transmitted to England chiefly from Smyrna and Constantinople, and manufactured into fine shawls, camlets, velveteens, plushes, braidings, decorative laces, and trimmings for gentlemen's coats. The manufacture is principally carried on at Bradford and Norwich. Although our imports of mohair are barely more than a hundredth part of our imports of wool, they are annually computed in millions of pounds avoirdupois.

THIBET GOAT (*Capra hircus*).—Cashmere shawls are made from the delicate downy wool found about the roots of the hair of this goat, which inhabits the high table-lands of Thibet. These oriental fabrics are woven by very slow processes, and are therefore very expensive, being sold in Paris at from 4000 to 10,000 francs a-piece, and in London at from £100 to £400. "The wool is spun by women, and afterwards coloured. A fine shawl, with a

pattern all over it, takes nearly a year in making. The persons employed sit on a bench at the frame—sometimes four people at each; but if the shawl is a plain one, only two. The borders are worked with wooden needles, there being a separate needle for each colour, and the rough part of the shawl is uppermost whilst it is in progress of manufacture."* To the people of Cashmere this manufacture is very important; about 16,000 looms are continually at work, each one giving employment to three men. The annual sale there is calculated at 30,000 shawls.

It has long been the aim of European nations, on account of the beauty and value of these shawls, to imitate them, and apply to their manufacture the more speedy and elaborate methods which modern science has placed within our reach. The French have been most successful, and shawls are now produced at Paris, Lyons, and Nismes, known in commerce as French cashmere, which closely approximate in stuff and style of work to the oriental, while much lower in price, although still costly. Norwich, Bristol, Paisley, and Edinburgh have also manufactured very good imitations of these shawls. The Cashmere wool imported for this purpose comes into Europe through Kasan, on the eastern bank of the Volga, and also directly from India and Persia.

The quantity of fine Thibet wool imported does not nearly reach that of the Angora goat, and the cherished Cashmere shawls have been closely imitated, if not excelled, at a much cheaper rate, by the looms of Paisley and France.

ALPACA (*Llama Pacos*, Gray).—The llamas may be regarded as the camels of South America, to which tribe of animals they belong. They inhabit the slopes of the

* *See* "Naturalist's Library." *Ruminantia*, Part 2. By Sir W. Jardine, Bart.

Peruvian Andes and the mountains of Chili, keeping together in herds of from 100 to 200, and never drinking when they have a sufficiency of green herbage. The alpaca is about the size of a full-grown deer, and very graceful in appearance. Its fleece is superior to that of the sheep in length and softness, spins easily, and yields an even, strong, and true thread. Pizarro found this animal used as a beast of burden, and its wool employed for clothing by the natives of that country.

Alpaca wool arrives in this country in small bales called ballots, weighing about 70 lbs., and generally in a very dirty state. It is sorted into eight different varieties, each fitted for a particular class of goods, and then washed and combed by machinery. The principal articles manufactured from it consist of alpaca lustres, fancy alpacas, and alpaca mixtures. Nearly all the alpaca wool imported into England is worked up in the Bradford district. Our annual supplies from Peru, New Granada, and other places in South America reach several millions of pounds avoirdupois.

The *Llama vicuña* and *L. guanaco*, other species of these animals inhabiting the same regions, yield fine hair, but of less commercial value.

Of our resources in wool, sheep, lamb, and alpaca, we export about a third part to our colonies and foreign countries.

The best wool is grown in Germany. The finest kind passes in commerce under the name of Electoral Wool. Next to Germany, Australia ranks in importance as a wool-growing country; the merino breed of sheep having been introduced there with unexampled success. In 1807 the first importation of Australian merino wool was received in England, amounting to only 245 lbs. It has now grown to national importance. Probably a more extensive and instructive collection of wools was never brought together

than that contributed to the Great Exhibition of 1851, in this country; showing, in a remarkable manner, the extent to which wool-bearing ruminants have been fostered by man, their wide geographical diffusion, and the influence of climate in modifying the characters of their fleeces. Samples of wool were there for inspection and comparison, from Chinese Tartary, Thibet, and India in the East, to the lately redeemed tracts of the United States in the far West; and from Iceland and Scandinavia in the North, to the Cape of Good Hope and Australia in the South.

The number of sheep in the world is, conjecturally, about one to every four of its inhabitants. According to latest official returns, which vary greatly in date, while from many countries no returns are received, the British Empire rears from a third to a half of the existing sheep, of which from thirty to forty millions belong to the United Kingdom, and a hundred millions to Australasia. Germany, France and her dependencies, Russia and La Plata, follow the British Empire in making up the remainder.

Although Europe now surpasses oriental nations in the artistic working of cotton and silk, yet the same cannot be said of the manufacture of shawls and carpets; for, besides the cashmere shawls made at Kashmir, in the kingdom of Lahore in Thibet, and also at Delhi in British India, carpets of peculiar and unequalled beauty still come from Persia and the Levant.

## VI.—LEATHER.

Leather is animal skin chemically changed by the process called tanning. The skin is prevented from putrefying, and rendered comparatively impervious to water, by the vegetable astringent, tannin, found in the bark, fruit, and leaves of various plants; this uniting with the gelatine of the skin, forms a tannate of gelatine. The skin, thus

changed, was called by our Saxon ancestors "lith," "lithe," or "lither"—that is, soft or yielding, whence our term "leather."

The skins are first cleansed from hair and cuticle, by being soaked for several days in a pit of lime water; this loosens the hair and cuticle, so that it is easily scraped off with a curved knife, upon a half cylinder of wood or iron, called a beam. The hair thus removed is sold to plasterers, who use it in their mortar. The skins are now steeped for a few days in a sour liquor of fermented rye or barley, or in weak sulphuric acid. By this process, called "the raising," the pores are distended and rendered more susceptible of the action of the tan. The skins are then put into the tan-pit, in alternate layers, with crushed oak bark, valonia, catechu, divi-divi, or other vegetable astringents, and the pit is filled with water. As the tannin is taken up by the skins, it becomes necessary to empty the tan-pit, and add fresh supplies of tanning material and water. The time required to tan the skins, or transform them to leather, depends on their thickness and other circumstances, and varies from four months to two years. When fully tanned, the leather, if cut through, is of a uniform brown colour—anything like a white streak in the centre showing incompleteness in the process. It is now stretched upon a convex piece of wood called a "horse," beaten and smoothed, or passed between cylinders to make it more solid and supple, and lastly, dried by suspension in an airy covered building.

Tanned leather undergoes the further operation of currying, or impregnation with oil. Leather, when it is received by the currier, is by him rendered smooth, shining, and pliable, so as to make it suitable for the purposes of the shoemaker, coachmaker, saddler, and harness-maker. First it is soaked in water to render it pliable, then stretched upon the beam and shaved smooth with a knife, next

rubbed with a polishing stone, and while still wet besmeared with a mixture of fish-oil and tallow, and hung up in a loft to dry. As it dries, the water only evaporates, the oil penetrating the pores of the leather. The grain, or hair side, is then blackened with copperas water, or sulphate of iron in solution, the iron uniting with the gallic acid of the tan, and producing an inky dye, or a gallate of iron. Leather so prepared is chiefly used for the uppers of ladies' shoes. Leather for the uppers of men's boots and shoes, on the contrary, is blackened on the flesh side, or waxed, as it is termed, with lampblack and oil, which is thoroughly rubbed in with a hard brush. The thick leather for the soles of boots and shoes is simply tanned without being curried.

But leather can be made without tannic acid. Skins may be preserved by means of alum and salt, and leather so made is called in the trade "tawed leather," and is quite as durable and much softer. Gloves are usually made from tawed leather. Skins intended to be tawed pass through a series of preliminary operations, resembling those by which skins are made ready for tanning, the use of ordures in the liquids being, however, indispensable. They are then immersed in a solution of alum and salt, to which, for the superior kinds of leather, flour and yolk of eggs are added. They are next dried in a loft, smoothed with a warm iron, and then softened on a stake, when they are dyed of various colours for gloves and ladies' boots. The French are skilled in this art. At Annonay, a town about fifty miles from Lyons, tawing operations are carried on so largely that tens of millions of kid skins are dressed there annually; and it has been computed that England and France consume many millions of eggs in the preparation of kid leather. The average number of leather gloves made in the United Kingdom would furnish each adult with a pair every year,

with a large reserve, while we import nearly as many more of French manufacture. All the figures of this important industry in tanned and untanned hides and skins, sum up in grand totals of millions of hundredweights.

The leathers known in commerce as CHAMOIS and BUFF LEATHER are prepared much in the same way as tanned and tawed leather, only that oil is substituted for the alum and tannic acid. Sheep and doe skins are also thus treated, more frequently even than those of the chamois goat. Wash leather is an example of this kind of preparation.

RUSSIA LEATHER, the smell of which is so agreeable, is prepared in the usual way, then tanned with the bark of the willows (*Salix cinerea* and *Salix capræa*), and afterwards curried with the empyreumatic oil from the bark of the birch-tree, which imparts to it its peculiar odour. M. Chevreul, who investigated the chemical nature of this odoriferous substance, called it *Betuline*.

MOROCCO LEATHER of the finer qualities is made from goat skins tanned with sumach, and inferior morocco, or roan, from sheep skins. The hair, wool, and grease are removed as usual, and the skin, thoroughly cleansed, is reduced to the state of simple membrane, called pelt. Each skin is then sewn by its edges into the form of a bag, the grain, or hair side, being outwards. A strong solution of sumach having been put into the bag, it is distended with air like a blown bladder, and the aperture tied up. About fifty of these skins, so distended, are thrown into a tub containing a warm solution of sumach—the tanning liquor—in which they are allowed to float. In a few hours they are tanned, removed from the bath, the sewing is then undone, and they are scraped and hung up in the drying loft. Red morocco leather derives its colour from cochineal, which, boiled in water with a little alum, forms a red liquor, in which the skins are immersed before being put

into the sumach bath. In the case of black morocco, the skins are sumached without any previous dyeing, and the black colour is given by applying with a brush, to the grain side, a solution of red acetate of iron; blue is communicated by indigo; puce colour by logwood, with a little alum; green is derived from Saxon blue, followed by a yellow dye made from the chopped roots of the barberry; and for olive, the skins are first immersed in a weak solution of green vitriol, and then in a decoction of barberry root, containing a little Saxon blue.

The thickest and most substantial leather now in general use is that made from the hides of the wild horses found throughout the Pampas in South America. It is employed for the soles of boots and shoes, harness, saddlery, leather trunks, hose for fire engines, pump valves, military gloves and belts. Deer skins are used for the finer kinds of morocco leather, and for bookbinding. Calf skins, tawed, are used by bookbinders; tanned and curried, by boot and shoemakers. Sheep skins, fleshed and stripped of wool or "dressed" by the fell-monger, then simply tanned, are employed for inferior bookbinding, for leathering bellows, and other purposes where a cheap leather is required. Morocco leather is used for coach linings, for covering chairs and sofas, bookbinding, and pocket-books. A thin leather called *skiver* is used for hat linings. There is an immense demand for thin leathers, and machinery for this purpose is now constructed with such accuracy that it will split a sheep skin into three parts. The grain side of the skin is then used for skiver, the middle for vellum and parchment, and the flesh side is transferred to the glue-maker. On parchment we inscribe our deeds, and on vellum all our state documents.

Every kind of skin can be tanned, from that of the African pachyderms, which takes years to prepare, and of

the marine mammals, to that of the alligator and of the true fishes. Elephant and rhinoceros hides yield leather of the density of armour-plates, and almost as invulnerable. The beluga and porpoise furnish leather of great durability, and the seal-tribe, with a fine grained product, as also with invaluable furs, plays a part in the manufacture only second to that taken by oxen and horses. The skin of the crocodile, with the plates left intact, is converted into purses, pouches, and bags, which are nearly indestructible, and shagreen, which supplies a light and lasting binding for cases of philosophical and scientific instruments, is provided by the sturgeon.

The leather manufacture of Great Britain ranks next in value and extent to those of cotton, wool, and iron. The skilled labour engaged in its different branches and the entire annual value of the produce, of which boots and shoes absorb two-thirds, make it a powerful factor in our national wealth. The great seat of boot and shoe making is Northampton. Most of the leather made in the kingdom, and the articles manufactured from it, are used at home. Our exports are also considerable, consisting of tanned unwrought leathers, boots and shoes, or cordwainery, saddlery and harness, and wrought leathers of various other sorts.

The Australian colonies are the great purchasers of these goods. Undressed English sheep skins are imported in yearly millions by the tanners of the United States, and foreign sheep skins, dressed in the United Kingdom, to about half the same export, find their market abroad.

## VII.—HAIR AND BRISTLES.

Hair, the covering of mammiferous animals, consists of slender elongated horny filaments, secreted by a conical gland, or bulb, and a capsule, which is situated in the

mesh-work of the chorion, or true skin. Bristles, hedgehog spines, and porcupine quills are all modifications of hair, having the same chemical composition, mode of formation, and general structure. Some kinds of hair are perennial, growing continuously by a persistent activity of the bulb and capsule, as human hair, and that of the mane and tail of the horse; other kinds are annual, the coat being shed at certain seasons of the year, as the ordinary hair of the horse, cow, and deer. Hair, of all animal products, is one the least liable to spontaneous chemical change, and in its various forms is valuable as material for numerous branches of industry.

Human Hair.—This is imported from Germany and France, and is furnished, the light-coloured by the German and the dark-coloured by the French girls, who look forward anxiously to the hair harvest for the means of purchasing trinkets and dresses. A head of hair weighs from eight to twelve ounces, and, according to its colour, is worth from thirty to sixty shillings per pound. In the spring, the Paris hair merchants send agents to all parts of France to purchase the beautiful tresses of the French girls, who cultivate an annual crop for sale with the same care as the farmer cultivates a field crop. About 200,000 lbs. are purchased in this way every spring, to be made into perukes, and false curls. Human hair is also manufactured into a variety of articles of personal adornment known in commerce as hair-jewellery, such as bracelets, armlets, lockets, brooches, necklace-rings, watch-rings, which are not infrequently worn in memory of the person to whom the hair belonged.

Horsehair.—This is collected in the various towns of England from ostlers and others, and sent up to London in sacks. Besides that supplied by our own horses, we import annually from Russia and South America many thousands of hundredweights. Horsehair is extensively used for

military accoutrements, and the short hair curled, as stuffing for mattresses; a cloth of great durability is manufactured from it, and employed in covering sofas, chair bottoms, and railway carriages. The first crinoline petticoats were made from horsehair, and hence the origin of the name (Latin, *crinis*, hair).

The hair of the elk, ox, goat, and camel is also extensively imported into this country. The hair pencils used by artists and termed camel's hair pencils, are composed of the fine hairs furnished by the sable, miniver, marten, badger, and polecat, as well as by the camel. They are usually mounted when small in quills, and when larger in tinned iron tubes. A good hair pencil is known by forming a fine point when moistened and drawn through the lips, all the hairs uniting in its formation.

BRISTLES are the stiff, glossy hairs growing on the backs of wild and domesticated swine. They are imported into this country from Germany, Russia, Denmark, and Poland, and used in the manufacture of brushes for the hair, clothing, teeth, and nails. Russia is the great mart for bristles, those of the Ukraine being most esteemed; France also sends us considerable quantities. Bristles are of various colours, black, grey, yellow; but the kind called the lily, on account of its silvery whiteness, is the most valued, and is used chiefly for shaving brushes, tooth brushes, and the softer descriptions of hair brushes. These bristles are saved by the peasantry of the forest, and are bought up by itinerant dealers, who make St. Petersburg a depôt of the accumulated produce, thence despatched to England. The trade is kept very close, and affords a striking illustration of the value of small things when massed. Our imports of hogs' bristles have exceeded at times three millions sterling from Russia alone. The bristle freights are among the first which come to hand in the spring on the breaking up of the Baltic ice.

THE PORCUPINE (*Hystrix cristata*, L.)—This animal is found throughout Southern Europe, and allied forms exist in North America. The porcupine quills sold in England are chiefly obtained from the European species, which is not common; therefore the quills are expensive. Work-piercers or eyeletteers for ladies, penholders, tooth-picks, fish-floats, and fancy work-boxes, are made from these quills.

## VIII.—HORNS AND ALLIED SUBSTANCES.

### 1. HORNS.

All hard and elongated processes projecting from the head are called horns. These natural weapons are either solid bone only, when they are called antlers, as in the stag, or they are composed of bone and horn, as in the sheep, goat, and ox. Horns of the latter kind consist of a hollow bony basis or core, on the surface of which is secreted a number of thin layers of true horny material. In the case of the giraffe, the horns consist of bone covered with hair, and are not deciduous. The horn of the rhinoceros is a mere appendage of the skin, and consists of horny fibres or hairs matted together. The antlers of the stag are shed annually, their fall being coincident with the shedding of the hair. True horns, or those which consist of axis and sheath, are never shed.

Chemically considered, horn may be regarded as intermediate in composition between albumen and gelatine, with a very small percentage of earthy matter. There is a graduated connection subsisting between the substance of horns, nails, claws, hoofs, feathers, scales, hair, and even skin. The animals that supply horn for our manufactures are principally oxen, bulls and cows, goats and sheep, their horns being preferred on account of superior whiteness and transparency.

The first process in horn manufacture consists in effecting a separation of the true horn from its bony basis. This is accomplished by macerating the horns in water, which causes putrefaction of the membrane lying between the core and the horny sheath, and renders the former easily separable from the latter. The horn then goes through the processes of scalding and roasting, which soften it, and render the laminæ capable of separation from each other. It is next slit with a strong pointed knife; and by the application of a pair of pincers, one to each end of the slit, the cylinder or cone of horn is opened until it is nearly flat. These flats are then placed on their edges, vertically, in a strong iron trough, having between them plates of iron, half an inch thick and eight inches square, which have been previously heated and greased. The plates are now compressed by means of wedges driven in at the ends, the degree of pressure depending on the use to be made of the horn. For the leaves of lanterns, it must be sufficiently strong to break the grain or cause the laminæ of the horn to separate a little, so as to allow of the introduction of a round pointed knife between them, to complete the separation; for combs, a very slight degree of compression is enough, otherwise the breaking of the grain would cause the teeth of the comb to split at their points. The sheets of horn are next removed from the press and placed, one at a time, on a board covered with bull's hide, secured with a wedge, and scraped with a draw knife, having a wire edge turned by means of a steel rubber. When reduced to the proper thickness the horn plates are polished with a woollen rag dipped in charcoal powder, a little water being added from time to time; they are then rubbed with rottenstone, and finished with horn shavings.

When combs are ordered which are too large to be made from a single plate of horn, two or more plates may be

united by the skilful application of pressure and of heat, sufficient to melt the horn; and, when well managed, the line of union cannot be detected. The Chinese are very skilful in this kind of work, as is evident from their large globular lanterns, some of which are four feet in diameter, and which are made of small united plates of coloured and painted horn. The painted toys known as Chinese sensitive leaves, which the heat of the hand or of a fire will cause to curl up as if alive, are made from the best of the thin films of horn scraped off the plate by the draw knife.

Horn is easily dyed, as can be seen in the above-named lanterns of the Chinese. In this country it is usually coloured of a rich reddish brown, and spotted to imitate tortoise-shell. This is effected by boiling together, for half an hour, a mixture of red-lead, pearlash, quicklime, and a little pounded dragon's-blood, and applying the mixture hot to the parts of the horn which it is intended to colour. For a deeper colour, a second application must be made; and for a blacker brown, the dragon's-blood is omitted.

Horn is manufactured into many other articles besides combs, such as snuff-boxes, drinking-cups, shoe-horns, and powder-horns. The fragments of horn, melted and compressed into a solid mass in moulds, form bell-pulls, handles for table knives and forks, knobs for drawers, and many other useful articles; or, if exposed to a decomposing heat in close vessels, these fragments develop prussic acid, and for this reason are in demand among the manufacturers of Prussian blue, and of the beautiful yellow prussiate of potash. The solid tips of the horns are always sawn off, because these parts are not lamellated, and, therefore, incapable of separation into plates. They are made into knife and umbrella handles, buttons, and the tops of whips.

The quantity of horn annually worked up in the manufactures of Great Britain, including the produce of our own

animals, is calculated in thousands of tons, of which the comb-makers alone consume a fifth part, giving to their finished product about ten times the value of the raw material. Horns of oxen are largely exported from South America, Buenos Ayres, Monte Video, and Brazil, the last taking, as regards size and quality, the first rank. The Indian buffalo from Siam furnishes a valuable black horn, while the Cape of Good Hope and Australian colonies also supply our markets with ox horns. The manufacture of articles from hoofs and horns is carried on at Aberdeen, in Scotland, where an immense establishment exists.

The hoofs of horses and ruminant animals are not so useful as horns, because heavier and less easily worked. They are made available chiefly in the manufacture of buttons and cheap combs. Ebonite and vulcanite, hardened compounds of indiarubber, have extensively supplemented horn-work, valuable and beautiful adjuncts to which are those in tortoise-shell and ivory.

## II. Whalebone.

Whale (*Balæna mysticetus*).—This animal furnishes the baleen or whalebone of commerce. Commonly regarded as fish, whales are nevertheless true mammals, producing their young alive, and suckling them for a considerable time. They are very sociable, swimming in large shoals, and sporting on the surface of the water in their native arctic seas.

Whalebone or baleen consists of numerous parallel laminæ descending perpendicularly from the palate of the animal. The object of this structure is to form an efficient sieve or strainer for the food of the whale, as it comes in with the water. Although provided with an immense mouth, this enormous creature has an œsophagus or food-pipe so small that he is compelled to nourish his vast bulk

by the consumption of some of the smallest inhabitants of the sea, his food consisting of small mollusca and crustacea. "To procure these insignificant morsels he engulfs a whole shoal of them at once in his capacious jaws, where they are, of course, entangled among the fibres of the baleen; the water is then strained off and expelled through the blow-holes, and the monster is thus enabled to pass his diminutive prey at his leisure into his stomach." *

The length of the largest pieces of baleen in a whale sixty feet long is about twelve feet, and the pieces are arranged in two rows, 300 in each. The average weight of each piece is seven pounds, and the weight of the whole is therefore 4200 pounds, or upwards of one ton and three quarters, worth about £160 a ton.

Whalebone is prepared for use by immersion for twelve hours in boiling water, which softens it for manufacturing purposes. It is valued for its flexibility, tenacity, compactness, and lightness, and is cut into quadrangular sticks for the ribs of umbrellas and parasols, the supports of stays, and other articles of ladies' wear. In thin strips whalebone is used for covering whip-handles, walking-sticks, and telescopes. These strips, also, are plaited like straw to form hats and bonnets, whilst the fine shavings are employed by the upholsterers as a stuffing for cushions, and for filling fire grates in summer.

### III. Osseous Substances.

Antlers.—The antlers of the different species of deer are very valuable for making a variety of useful and ornamental articles. The chief supply is furnished by the elk, wapiti, stag or red deer, and fallow deer. In Switzerland brooches, pins, and bracelets are made from stag's horn; in

* "Natural History of the Animal Kingdom." By W. S. Dallas, F.L.S. 1856.

Sheffield the whole shaft of the horn is used in making the handles of carving-knives, or it is cut up into small plates and riveted on to an iron case for the handles of pocket and pen knives. Some hundreds of tons are annually imported from Hindostan and Ceylon for this purpose, supplemented by about a quarter as much from Germany, Russia, Spain, and Italy, and from our own parks. Many thousand head of deer are annually killed in Greenland, and their horns sent over to this country. The shavings of the horns are employed for the purpose of making ammonia, which has therefore long been popularly known as "hartshorn."

Ivory.—Our supplies of ivory are derived chiefly from the Asiatic and African elephants; the tusks or canine teeth of these animals furnish the article, those of the African species being the most valuable. Elephants' tusks from two to ten feet in length, and weighing from 6 to 160 pounds, are imported into this country from Senegambia, Guinea, Mozambique, and Sofala; and also brought from the interior of Africa in caravans and shipped at Alexandria, Tunis, Tripoli, and Cairo. We receive them, besides, from Bengal, Burmah, Siam, Cochin-China, Ceylon, Sumatra, and Java. There are large buildings erected in Birmingham for the manufacture of ivory, and also at Nuremberg, in Germany. The Chinese are unrivalled in this manufacture. Their ivory balls, carved one inside another, are marvels of patience, industry, and ingenuity; and their chessmen, cabinets, drinking cups, and numerous other articles are most elaborate.

The Japanese, nevertheless, excel the Chinese in *artistic* ivory work. Their carved representations, grotesque and refined, of figures, both animate and inanimate, excite wonder and admiration.

Of the ivory from Asia, that of Siam is superior to the Indian; but African ivory excels both, being less liable to discolour in use.

Generally and technically under the name of ivory are comprised the teeth of the narwhal (*Monodon monoceros*), walrus (*Trichecus rosmarus*), and hippopotamus (*Hippopotamus amphibius*), which, like ivory, are worked up into a variety of things, and always keep white.

Ivory is largely consumed in the manufacture of billiard balls, which cost from six to twelve shillings each, and are so nicely turned that they are perfectly spherical, and made to correspond accurately in size and weight, even to a single grain. The greatest consumption of ivory is undoubtedly in connection with the cutlery trade. A large amount is also worked up in the manufacture of the backs of hair and tooth brushes.

The miniature tablets, so invaluable to the artist, are cut from off the tusk by an extremely thin saw acting horizontally, just as we pare an apple, so that from a solid tusk, of the ordinary size, a sheet of very considerable length can be obtained. In the Great Exhibition of 1851 one manufacturer exhibited a sheet of ivory sixty feet in length, obtained without joining, and which had thus been pared off from a single tusk. We import annually 50,000 elephants' tusks, weighing 10,000 cwts.; consequently not less than 25,000 elephants are killed annually to supply the English market alone.

The material of ivory is so valuable that economy in its use is necessarily studied, and the smallest fragments are preserved. The "refuse" of ivory is used for making the finest black colour (*noir d'ivoire*) by converting it into charcoal in air-tight vessels. Such trade "refuse," consisting of ivory scrapings, shavings, and sawdust, when boiled, makes an excellent jelly, quite as good as calf's-foot jelly, and with the advantage that it suffers no change by keeping. This material is therefore saleable to the confectioner and pastrycook.

England and France are the only countries of Europe which make ivory-work a distinct industrial art, London and Sheffield being the centres in England, as Paris and Dieppe are in France. Though the consumption of ivory is large in China and Japan, India and Africa, there must be an annual destruction approaching to 30,000 elephants, to supply only the English and French demands.

Bone.—The skeleton or framework of animal bodies consists of bones articulated with each other, which protect the vital organs, and form a basis or support for the softer parts, and for the attachment of the muscles or organs of locomotion. In the arts, bones are extensively employed by the cutler, comb and brush maker, chemist, confectioner, and agriculturist. Common bone is manufactured into buttons, combs, knife, fork, and brush handles, card cases, parasol handles, book folders, and numerous other articles. The chemist obtains phosphorus, sal-ammoniac, and charcoal from bone, and the farmer a most valuable manure, super-phosphate of lime, which has a quick and efficient action on the crop. Large quantities of bones of oxen are imported to Great Britain from Buenos Ayres, and the bones also of seals are brought home by the sealers. Such, indeed, is the growing demand, that the skeletons of every animal, both wild and domestic, including whales, contribute to the imports, which have reached the annual value of a million sterling. Our home supply, about equal in extent, though carefully gathered, is quite inadequate, and the whole world is ransacked to fill our stores.

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## *PRODUCTS OF THE CLASS AVES.*

Birds are warm-blooded, vertebrated animals, characterised by a double circulation and respiration, the adaptation of their anterior extremities for flight, oviparous reproduction,

and a covering of feathers. The following classification, founded on certain modifications in the structure of the beak and foot, is that which is generally adopted by naturalists:—

1. *Raptores* (Latin, *raptor*, a robber), or birds of prey, having a strong, curved, sharp-pointed beak, short robust legs, and a foot furnished with three toes before and one behind, which are armed with long, strong, crooked, and more or less retractile talons, adapted to seize and lacerate their prey. Examples: eagle, hawk, and vulture.

2. *Insessores* (Latin, *insideo*, I sit on), or perching birds, having three toes before and one behind, slender and flexible, with claws, long, pointed, and slightly curved; a foot, in fact, organised and adapted for the delicate operations of nest-building, grasping the slender branches of trees, and perching on them. Examples: sparrow, robin, and crow.

3. *Scansores* (Latin, *scando*, I climb), or climbing birds, with the four toes arranged in pairs, two before and two behind, a conformation of the foot most suitable for climbing trees. Examples: woodpecker, cuckoo, and parrot.

4. *Columbidæ* (Latin, *columba*, a pigeon), includes pigeons and doves.

5. *Rasores* (Latin, *rado*, I scratch), or scratching birds, having three toes before and one behind, strong, straight, and terminated by robust, obtuse claws, adapted for scratching up the soil. Examples: turkey, pheasant, partridge, and the common barn-door fowl.

6. *Cursores* (Latin, *curro*, I run), or running birds, with wings unfitted for flight, and feet formed for running swiftly over the ground, with two and sometimes three toes in front, and none behind, except in the apteryx. Examples: ostrich and cassowary.

7. *Grallatores* (Latin, *grallator*, a stalker), wading birds with long legs, the three anterior toes long and slender, and the posterior toe elevated and short; a form of foot and leg

which enables the bird to seek its food in water along the margins of rivers, lakes, and seas. Examples: crane, heron, sandpiper.

8. *Natatores* (Latin, *natator*, a swimmer), swimming birds, including those which have the toes united by an intervening membrane. The body is protected by a dense covering of feathers, and a thick down next the skin; the whole organisation is adapted for aquatic life. Examples: duck, swan, and goose.

The products of the class Aves consist of—

## I.—FOOD.

All these orders of birds, with the exception of the first, afford flesh which may be eaten. The eggs of many of them are very nutritious, especially those of the Rasorial birds: 1,002,788,000 were imported from abroad in 1885, and the trade is always increasing. In one case, even the nest is available as food; namely, the Chinese edible birds' nests, constructed by a Javanese swallow. The collecting of these nests employs numbers of people, as they are largely exported to China from Java, Ceylon, and New Guinea. The Chinese concoct of these nests a soup which they favour as much as an English epicure his green turtle. A large share of the commercial value of birds lies in their feathers.

## II.—FEATHERS.

A feather consists of three parts, the quill, the shaft, and the vane. The quill is that part of the feather by which it is attached to the skin; it is cylindrical, hollow, and semi-transparent, possessing in an eminent degree the qualities of lightness and strength. The shaft is covered by an outer layer of firm, horny material, like that which forms the quill, and encloses a soft elastic substance called the pith. The

vane consists of barbs and barbules. The barbs are attached to the sides of the shaft; the barbules are given off from either side of the barb, and when long and loose, they characterise the form of feather known as a "plume," *e.g.*, that of the ostrich, which, commercially considered, is the most valuable of feathers. The development of feathers is always preceded by that of down, which constitutes the first covering of young birds. Their colours are due to peculiar organic pigments, which may be separated by appropriate solvents. The beautiful play of colours shown by some feathers is referable to a decomposition of light, analogous to that produced by mother-of-pearl and other striated surfaces.

The preparation of feathers for military decoration, or for the toilette, forms the art of the plumassier, the French term for the artisan who works on them. Feathers may be dyed a variety of beautiful colours, and of these, rose colour or pink is given by safflower and lemon juice, and deep red by a bath of Brazil wood boiling hot, after aluming; indigo supplies the blues of every shade, and turmeric the yellows, alum being the usual mordant.

## Ornamental Feathers.

The Ostrich (*Struthio camelus*).—The elegance of these feathers arises from their slender stems and disunited barbs. Those taken from the living, or from recently killed birds are far more beautiful than the cast or dropped ones. The feathers from the back and above the wings are the best; next those of the wings and tail. Ostrich feathers dyed black—for which purpose logwood, copperas, and acetate of iron are used—are sold to undertakers as mourning plumes; a full set is worth from £200 to £300. Ostrich feathers are scoured with soap, and then bleached. Fine white ones are worth from seven to eight guineas a pound.

The finest white feathers of this bird, which is indigenous to Northern and Central Africa and Arabia, come from Aleppo, in Syria. Good ostrich feathers are also received from Algiers, Tunis, Alexandria, and Cairo, and inferior ones from Senegal and the island of Madagascar.

THE LITTLE EGRET (*Herodias leuce*) is found in all the countries on the Mediterranean coast, and in Asia as far as the East Indies; an allied species, *H. ægretta*, is a native of tropical America. The feathers of both species are of the purest white, very delicately formed, six or eight inches in length, with slender shafts. The Turks and Persians embellish their turbans with them, and they form plumes for ladies' head-dresses in this country and on the Continent.

THE GREAT WHITE HERON (*Ardea alba*) inhabits the shores of the Caspian, the Black Sea, and lakes of Tartary, and is also found in America and Africa. The largest and most expensive white heron feathers are furnished by the plumage of this bird.

COMMON HERON (*Ardea cinerea*).—The black heron feathers are supplied by this species, which is found throughout Europe, but especially in Prussia, Poland, and Russia. We receive the greatest quantity from Siberia.

ADJUTANT (*Leptoptílis Argála*), and a kindred species (*L. Marabou*), furnish the exquisitely fine and flowing plumes termed "Marabou feathers." The former species is the well-known scavenger bird of India, its name being derived from its habit of frequenting the parade-grounds; the latter is a native of Africa.

It is impossible to enumerate all the birds whose beautiful plumage supplies us with ornamental feathers. The feathers of the bird of paradise, the gold and silver pheasants, the peacock, of the several species of *Ibises*, the flamingo, the beautiful wing and tail feathers of the Argus pheasant, and the wing of the partridge and ptarmigan are all worn in

children's and ladies' hats. Cocks' feathers furnish plumes for the French soldiers; eagles' feathers are worn in the hat and bonnet in Scotland, and a plume of them is a mark of distinction amongst the Zulus in South Africa. The wing and side feathers of the turkey supply trimmings for articles of ladies' apparel, and are made into victorines, boas, and muffs.

Artificial flowers made from feathers are now much worn by ladies. The feathers selected for their manufacture are chiefly those of a purple, copper, or crimson colour, from the breasts and heads of humming-birds.

*Feathers are also worn as articles of clothing.*—The skin of the swan, after being properly prepared, is used for muffs, linings, and a variety of other articles of dress; the skin and feathers of the penguin, puffin, and grebe (*Podiceps cristatus*) are worn as clothing on account of their beauty and warmth, supplying suitable material for victorines, tippets, boas, cuffs, and muffs, and other articles of winter attire. The native inhabitants of the arctic regions, in some parts, make themselves coats of birds skins, which are worn with the feathers inside. Confucius, the Chinese philosopher, writes, that ere the art of wearing silk and hemp was understood, mankind used to clothe themselves with the skins of beasts and with feathers; and it is very certain that the Chinese are now very skilful and ingenious in the art of plumagery or feather-working. They manufacture garlands, chaplets, frontals, tiaras, and crowns of very thin copper, on which purple and blue feathers are placed with much taste and skill.

## BED-FEATHERS.

The lower barbs in feathers are usually loose, and form the down, which is called the "accessory plume." The quantity of this down varies in different species of birds, and even in the feathers taken from different portions of

the body of the same bird. It is most abundant on aquatic birds; and as the value of bed-feathers depends on its amount, the feathers of ducks, swans, and geese—which have the "accessory plume" nearly as large as the feather—are the most esteemed.

The qualities sought for in bed-feathers—softness, elasticity, lightness, and warmth—are combined in common goose feathers; they are considered best when plucked from the living bird, and this cruel operation is repeated from three to five times in a year. Young birds are plucked as well as those of mature growth—the early plucking being supposed to favour the growth of the feathers. The less valuable kind of feathers, obtained from turkeys, ducks, and fowls, are also used for bed-stuffing, and are called "poultry feathers."

EIDER DUCK (*Anas mollissima*).—This bird furnishes the softest, finest, and most valuable down-feathers that are in the market. Eider down is procured from the nest of this bird, which robs its own breast of feathers in order to make a warm home for its young. The Eider ducks build their nests in great numbers, in almost inaccessible rocky situations on the coasts of Ireland, Scotland, the Faroe Islands, Lapland, Nova Zembla, and Spitzbergen; and these nests are, at great risk of life, annually plundered of their down by the fowlers. Eider down comes to this country in the form of balls, about the size of a man's fist and weighing three or four pounds. It is so fine and soft, that if one of these balls is spread and warmed over hot coals, it will expand and fill a bed big enough for two persons. Eider down makes a warm winter coverlet, for which it is singularly adapted. Beds of down can be distinguished from feather beds by their elasticity, which causes them to rise again when pressed.

Our imports of feathers reach us chiefly from Russia,

Hamburg, and France. Home feathers form part of the pin-money of the farmer's wife. Birds of Paradise, entire, ostrich-plumes for ladies' wear and pageantry, and other decorative feathers are furnished by the warm regions of both hemispheres. The grebe tribe, denizens of the polar ice, give their close-set feathered skins for muffs and mantles of the choicest warmth and beauty.

## Quill Pens.

The earliest pens, such as were used for writing on *papyrus* with a fluid ink, were made of reeds. Reed pens are still in use in Arabia, as they suit the Arabic character better than quill pens. These reeds are collected near the shores of the Persian Gulf, whence they are sent to various parts of the East. Quill pens are chiefly supplied by the goose, swan, and crow—the ostrich, turkey, and other birds occasionally contributing. Crow quills are usually employed in fine drawings, on account of the fine point to which they can be brought. Goose quills are employed for ordinary writing; but swan and turkey quills, being larger, are preferable for copying.

Two principal sorts of quills are known in commerce—viz., Dutch quills, which are transparent and glass-like, and Hamburg quills, which are milk-white and clouded. Dutch quills are much esteemed; the Dutch were the first to find out the art of preparing quills for market, by removing the oil which impregnates them and prevents the ink from flowing freely along the pen. Quills are obtained in the greatest quantities from the countries along the Baltic; Hamburg is still the principal place for preparing and exporting them. Next to the Hamburg and Dutch quills, those of Riga are much liked, especially in England.

The manufacture of steel pens does not appear to have diminished the demand for quills. In 1855 we imported,

independently of our home supply, 26,500,000 goose and swan quills, and the imports do not diminish. The quills used are the five outer feathers of the wing, which are classified according to the order in which they are fixed in the wing, the second and third being the best. With proper management, a goose may afford twenty quills during the year.

In the fens of Lincolnshire, geese are kept in large numbers. During the breeding season they are lodged around the owner's house. A gooseherd, it is said, can distinguish every goose in the flock by the tones of its voice.

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## *PRODUCTS OF THE CLASS REPTILIA.*

REPTILIA (Latin, *reptilia*, from *repto*, I creep).—Cold-blooded, vertebrated animals, having a heart so constructed as to transmit only a portion of the blood to the lungs. The blood is therefore imperfectly oxygenated, and there is a lower degree of animal heat. The amount of venous blood, however, transmitted to the general system varies in the different reptiles, and in proportion as there is less or more of it, is there a corresponding difference in temperature and vital activity.

As reptiles have no need of preserving a temperature many degrees warmer than that of the medium in which they live, they are covered with scales, or hard bony plates, and without the warm clothing of the birds and mammalia.

The class Reptilia is divided into four orders, viz.:—

1. *Chelonia* (Greek, *chelone*, a tortoise), which are characterised by the enclosure of the body in a double shield or shell, out of which extend the head, tail, and four extremities. Examples: tortoise and turtle.

2. *Lacertilia*, or *Sauria* (lizards), having the body and tail elongated, the jaws furnished with teeth, the skin covered with scales, and the feet generally four in number. Examples: green lizard and blind worm.

3. *Crocodilia* include the alligators of America, the true crocodiles of Africa, and the gavials of Asia. Gigantic lizards, covered with closely-set bony plates.

4. *Ophidia* (Greek, *ophis*, a serpent), which are distinguished by the absence of the extremities, as in the snake.

The Chelonia are commercially the most valuable of the above orders, as we derive from them two important articles—turtle soup and tortoise-shell—the former the greatest luxury of the table, and the latter the most prized of horny materials.

GREEN TURTLE (*Chelonia mydas*).—This is one of the largest of the genus, often measuring five feet in length, and weighing between 500 and 600 lbs. It receives its name from the green colour of its fat. Its flesh is much esteemed, and in this country is regarded as a great luxury, large quantities being continually imported for the supply of the London taverns alone. Green turtles are found in the Atlantic ocean, where they are widely distributed. They are especially abundant near the Bahama Islands, and when they come ashore to deposit their eggs in holes in the sand are usually caught, either by harpooning or by turning them over on their backs, for when once turned they cannot get on their feet again. The Chinese catch them with the sucking-fish (*Remora*), which is put into the water with a string tied to its tail. The remora darts at the turtle, to which it firmly adheres by means of its sucking apparatus, and both fish and turtle are then drawn into the boat.

Mr. Darwin thus describes the capture of this turtle at Keeling's Island: "The water is so clear and shallow that at first a turtle quickly dives out of sight; yet, in a canoe or

boat under sail, the pursuers, after no very long chase, come up to it. A man standing ready in the bows at this moment dashes through the water upon the turtle's back; then, clinging with both hands by the shell of the neck, he is carried away till the animal becomes exhausted and is secured. It was quite an interesting chase to see the animals thus doubling about, and the men dashing into the water trying to seize their prey."

HAWK'S-BILL TURTLE (*Chelonia imbricata*).—The horn-like plates of this animal, and also of the carett, or giant tortoise (*Testudo caretta*), which lives in all the seas of the torrid zone, furnish the tortoise-shell of commerce. The Island of Ascension is a place of resort for these reptiles, and thousands of them are annually destroyed there. In most species of tortoise the scales which compose the carapace or upper covering adhere to each other by their edges, like inlaid work, but in the hawk's-bill turtle these scales are imbricated, or overlap one another, like the tiles on the roof of a house. The head is also smaller than in the other tortoises; but the neck is longer, and the beak narrower, sharper, and more curved, resembling a hawk's bill. The lamellæ or plates of the shell are semi-transparent, and variegated with whitish, yellowish, reddish, and dark-brown clouds and undulations, so as to constitute, when properly prepared and polished, an elegant article for ornamental purposes. The shell of this animal is therefore largely imported into this country, as much as thirty tons' weight being annually consumed by the manufacturers. Tortoise-shell is used for the handles of pen-knives and razors, spectacle frames, card cases, ladies' side, back, and dressing combs, and for inlaying work-boxes. The best tortoise-shell comes from the Indian Archipelago, where Singapore is the principal port for its exportation. It is also sent from the West Indies, from the Gallapagos Islands,

situated on the west coast of South America, and from the Mauritius, Cape Verde, and Canary Islands.

"A large number of turtle eggs are secured every year for the sake of turtle oil. The eggs, when collected, are thrown into long troughs of water, and, being broken and stirred with shovels, they remain exposed to the sun till the yolk, the oily part, is collected on the surface, and removed and boiled over a quick fire. This animal oil, or 'turtle grease,' is limpid, inodorous, and scarcely yellow; and it is used not merely to burn in lamps, but in dressing victuals, to which it imparts no disagreeable taste. The total gathering from the shores between the junction of the Orinoco and Apure is 5000 jars, and it takes about 5000 eggs to furnish one jar of oil." *

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## PRODUCTS OF THE CLASS AMPHIBIA.

*Rana esculenta* (edible frog).—This species is eaten in France.

*Rana pipiens* (American bull-frog).—The hind limbs are considered a great luxury, and are exposed for sale in the markets of the United States.

*Siredon pisciforme* (axolotl).—Inhabits the lakes near the city of Mexico, where it is very abundant, attaining a length of from ten to fifteen inches. Thousands are sold, and esteemed a great delicacy by the Mexicans.

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## PRODUCTS OF THE CLASS PISCES.

VERTEBRATE animals inhabiting water, breathing by means of branchiæ or gills—vascular organs into which the cir-

* See Bates' "River Amazon."

culating fluid enters, and which is submitted in a state of minute subdivision in the vessels of the gills to the air contained in the water, and so oxygenated—swimming by means of flattened expanded organs called fins, the entire body being mostly covered with cartilaginous scales. The specific gravity of fishes is nearly the same as that of the watery element in which they live. Most of them have a membranous bag at the lower side of the spinal column, known as the "air bladder," which is so organised that the fish can vary its specific gravity by contracting or expanding the bladder, expelling the air or taking it in, and so sink or rise in the water at pleasure. It is somewhat remarkable that this air-bladder is quite rudimentary or altogether absent in fishes which live much at the bottom of the water, seldom or never coming to the surface, such as plaice, turbot, and sole. Progression in any direction is affected by the movements of the tail. The craving for food seems to be that which gives the chief impulse to their movements. Their rapacity has no bounds whatever; even when taken out of the water, and just expiring, they will greedily swallow the very bait which lured them to destruction.

The class of fishes has been subdivided by Cuvier into two sub-classes.

1. *Pisces ossei*, or bony fishes, comprising those which have a true bony skeleton. Examples: herrings, salmon, and cod.

2. *Pisces cartilaginei*, or cartilaginous fishes, including those in which the skeleton never passes beyond its primitive condition of gristle or cartilage. Examples: the sturgeon, ray, and shark.

The first sub-class of osseous fishes are arranged according to the character of their organs of locomotion into:—

*Acanthopterygii* (Greek *akantha*, a spine, and *pterugion*, a fin), or spiny-finned fishes. Examples: perch, mackerel, and mullet.

*Malacopterygii* (Greek *malakos*, soft, and *pterugion*, a fin), or soft-finned fishes. Examples: herring, salmon, carp, and trout.

Fish constitutes an important article of commerce, furnishing us with immense quantities of oil and an abundance of food. Great Britain possesses a coast-line of 3000 miles in extent, while that of Ireland is about 2000 miles, and the greater part of the shores of both islands abound in those species of fish which exist in the largest numbers and yield the most acceptable and nutritious food. Hence a hardy and adventurous race of fishermen has risen, well supplied with vessels beautifully built, and with materials of the best description. We shall notice only the fisheries commercially most valuable.

HERRING (*Clupea harengus*).—This fish appears in vast shoals upon our coasts from July to November, when it forsakes the deeper portions of the sea where it habitually dwells and comes into the shallow shore water for the purpose of spawning. These shoals, animated by a common impulse, are so enormous, that the sea for miles round shines with a silvery lustre from their glittering scales. There is thus brought within the reach of man an abundant supply of nutritious food, which would otherwise be lost in the depths of the ocean.

The British herring fisheries are principally carried on off Galway, Mayo, in the estuary of the Shannon, at Bantry, and Waterford in Ireland; at Cardigan Bay and Swansea in Wales; at Yarmouth, Lowestoft, Hastings, and Folkestone in England; and on the coasts of Caithness, Sutherland, Ross, Aberdeen, Banff, Moray, and Berwickshire, in Scotland. In the harbour of the small town of Wick, in Caithness, as many as 2000 boats, each having five or six men, have been congregated at one time during the herring season. Shetland has developed into a great fishing station. Since 1877

the poor simple islanders have multiplied their annual take a hundred times over. The herring or "Great fishery" is of such importance, that its failure, even for a season, would be a wide-spread public calamity. Its importance has been much augmented by the use of cotton nets, which, though not quite so strong as those formerly in use, are so much lighter, that an area of netting, several times larger than before, can be carried in each fishing smack. The greatness of the fishery may be inferred from careful computations of the number of herrings in the North Sea alone, giving a total of 300,000 millions. Of this incomprehensible multitude, not one per cent. can be destroyed by the united efforts of man, the sea-birds, and the monsters of the deep. Yet we must multiply the shoals many times over for the herrings of the wide and open sea, and when we cross to the American borders of the Atlantic, nature reduplicates the shoals.

Besides the consumption of fresh herrings, still larger quantities are pickled, smoked and dried, and bloated or half cured. In these various states an extremely valuable export trade is prosecuted. Holland and Norway pursue the herring fishery with ardour. Sweden, Denmark, and France are also largely engaged in the same pursuit.

The PILCHARD (*Clupea pilchardus*) closely resembles the herring. This fish is very abundant on the coasts of Cornwall during the spawning season in July. Like the herring, it is taken with the net at night. The average annual produce of the Cornish pilchard fisheries cannot compare with that of the herring, yet, of itself, is of great magnitude. It is the livelihood of young and old in the fishing town of St. Ives, whose prosperity during the winter months is dependent upon the success of the previous season's take. The fish are cleaned, pressed for oil, and cured, and many thousands of barrels are exported to the Mediterranean in

exchange for the delicate anchovy and sardine, the first preserved in brine and the last in oil.

The SPRAT (*Clupea sprattus*), although smaller than the herring, is also very abundant, and furnishes an acceptable supply of cheap and agreeable food. It is caught during the winter months on the coasts of Kent, Essex, and Suffolk, and in such vast quantities as to give rise to the Stow Boat fisheries round the Thames estuary, where it is taken for manure, many thousand tons being sold to the farmers at from 6d. to 8d. per bushel for this purpose. Forty bushels of sprats serve for an acre of land.

WHITEBAIT (*C. sprattus*, juv.)—Every one familiar with an English newspaper has heard of the whitebait dinner, or fish dinner, at which whitebait is the chief dish—annually held at Greenwich by the members of the British Cabinet and the Lord Mayor and Aldermen of London. This little fish, so much prized for its delicious flavour, was formerly regarded as the fry of the shad, while other naturalists maintain that it is quite a distinct species. Gunther, an authority of high repute, has recently shown that whitebait is the fry of the sprat. It has never been found with natural ova, and therefore does not ascend rivers for the purpose of spawning.

SARDINE (*Clupea sardina*) and ANCHOVY (*Engraulis encrasicolus*), both closely allied to the herring, replace that fish in the Mediterranean. The former is taken in great abundance off the shores of Sardinia and Brittany, and packed in small metallic boxes, and is much esteemed as a breakfast relish. The latter, a small silvery fish four or five inches in length, is found on the coasts of France and Portugal. The head and entrails having been removed, it is salted, packed in barrels, and in this state reaches our shores. Here they are bottled to be eaten as a dainty or pounded for fish sauce and anchovy paste.

Mackerel (*Scomber scombrus*).—This well-known and beautiful fish, so valuable as an article of food, is found in abundance on the south and south-east shores of England. Out of the water it soon dies, and becomes quickly tainted. Those caught in the months of May and June are preferred. "Mackerel will bite at almost any bait, hence quantities are taken by hook and line. A slice cut from the side of a mackerel near the tail is a successful lure, or even a strip of red leather or scarlet cloth." * 142 lasts of mackerel have been taken at Yarmouth (a last is 10,000), this equals 1,420,000 individual mackerel. The Irish mackerel fisheries have assumed proportions which promise wealth to the country, particularly to the port of Kinsale, whence are sent to Billingsgate such fine and large samples as are not excelled even by those from Norway. Steam transit has given an impetus to the cultivation of this productive fish farm, formerly quite neglected, in which the Irish play, however, little more than a passive part, while outsiders reap the chief part of the harvest.

Salmon (*Salmo salar*).—This is a soft-finned fish, the body being adorned with spots, and brilliantly coloured, and covered with cycloid scales. The species pass by almost insensible gradations into the clupeoid or herring family. Like the herrings they inhabit the sea, but ascend the rivers nearly to their sources in order to deposit spawn, displaying an amount of perseverance and activity in getting there which is astonishing. Cataracts and weirs ten and twelve feet in height are cleared at a single leap, and should the fish be foiled the first time it tries again and again until successful. After spawning salmon are unfit for food. They descend the rivers with the floods, with which winter usually closes, to the sea, where they soon recover their condition, and return ample in size and rich in human nourishment, ex-

* *See* article *Fisheries*, "Encyclopædia Britannica," Eighth Edition.

posing themselves in narrow streams, as if nature intended them as a special boon to man. Such salmon as are taken in estuaries or rivers are the property of those to whom the estuaries and rivers belong; but latterly, considerable quantities have been caught in bays and in the open sea, where the fishing is free. The London markets are principally supplied with salmon sent up from the Tweed, Tay, Don, and Dee, and from Norway, preserved fresh by being packed in ice. The fishing is usually carried on in summer, and when the take is greater than can be conveniently sent off fresh, the residue is salted, pickled, or dried for winter consumption at home, or for foreign markets. Of late years there has been a decrease of salmon in the English and Scotch rivers, the result of poaching and over-fishing. Pecuniary penalties are inflicted on poachers and trespassers; and in Scotland the rivers are shut up for nets—on the Tweed from September 15th to February 14th, and north of the Tweed from August 27th to February 10th, except in a few cases; for rods, the close time is some two months later.

Cod (*Morrhua vulgaris*).—This valuable fish is spread throughout the seas of Europe from Iceland to Gibraltar, and abounds on the eastern coast of North America from 40° to 66° N. lat., particularly around Newfoundland. It spawns in British waters about February, and is in the best condition as food from the end of October to Christmas. It is amazingly prolific, 9,384,000 ova or eggs having been counted by Leuwenhoeck in the roe of one female. As the cod frequents deep water it can only be taken by long deep-sea lines, hooks being fastened at regular distances along their entire length. It is usual to fish for cod in water from twenty-five to forty fathoms in depth. Cod are voracious, and easily taken with a variety of baits.

The British cod fishery is carried on in a number of places contiguous to the shores of our islands. The most pro-

ductive are those on the sandbanks off the coasts of Norfolk, Suffolk, Essex, Lincolnshire, and the Orkney, Shetland, and other islands. The London market is supplied chiefly from the Norfolk and Lincolnshire fisheries. Fresh cod are usually kept alive in welled smacks, and are in this manner brought in good condition from the most distant points of our coasts. The well is capable of holding about fifty score, and receives its water directly from the sea, through perforations in the bottom of the vessel. These vessels are either anchored in a tide-way, or one of the sails is kept set, so as to produce a constant heaving motion, and, in consequence, a perpetual change in the water of the well. The smacks never go farther up the Thames than Gravesend, as the fresh water intermingles with the salt above that point, and proves destructive to the fish.

The greatest cod fishery in the world is on the banks of Newfoundland. These banks are based on a large rocky shoal about 600 miles in length and 200 in breadth, being, in fact, the top of a vast submarine plateau, over which the ocean rolls. This place is a great rendezvous for cod, which resort there to feed on the worms, which are plentiful in these sandy bottoms, and on account of its vicinity to the polar seas, whither they return to spawn. The cod are found here in such numbers that although maritime nations have for centuries worked indefatigably at these fisheries, not the slightest diminution of their abundance has been noticed. The Newfoundland cod fisheries are carried on now principally by the French and Americans. The British interest in them has declined, as we have transferred the site of our operations to the coast of Labrador, where many English sailors, and specially equipped schooners, are employed. The Americans fit out their vessels chiefly at Boston, and thus from their vicinity to these fishing grounds possess advantage over the English. Immense quantities of cod

are sent by England, France, and Holland, partly salted and dried, to Southern Europe, chiefly for consumption during Lent and the other fasts of the Roman Catholic Church.

TURBOT (*Rhombus maximus*).—Taken on all our coasts. The English markets, however, are supplied chiefly with Dutch turbot, which is preferred; these are caught on the sand banks lying between Holland and the eastern coast of England. While the Dutch furnish our tables with the finest turbot, the Norwegians complete the service with the luxury of lobsters, about a million of which they send to us yearly from the rocky fiords where these crustacea abound,—partly to be consumed as turbot sauce, partly as a salad or as a choice and independent dish.

SOLE (*Solea vulgaris*).—The sole is common on the British coasts, and in season from May to November. The principal fishing stations are on the south coast, from Sussex to Devonshire, especially at Brixham and Torbay. *Plaice*, *flounders*, *dabs*, *halibut*, and *brill*, all belonging to the true flat fish, are also in great request for their delicate and nutritious food, which is found particularly suitable as diet for invalids.

LAMPREY (*Petromyzon marinus*).—An eel-like cartilaginous fish, having a funnel-shaped mouth, surrounded by a circular suctorial lip, by means of which it adheres to stones (Greek, *petron*, a rock; and *muzo*, I suck) and to the bodies of those fish on which it feeds. Formerly the lamprey was considered a great delicacy, and one of our kings (Henry I.) is said to have died in consequence of eating it too freely. Although not so much in demand now, great numbers are still furnished from the North Sea, the Baltic, and the German rivers, where they abound. Lampreys reach this country packed in jars with vinegar, spices, and bay leaves.

Common Sturgeon (*Acipenser sturio*) belongs to the group of cartilaginous fishes. The body is elongated, spindleform, and usually from five to six feet in length; the head, which is depressed and protruded into a triangular snout, is covered with rows of large tubercular bony plates. The sturgeon is abundant in the seas of northern Europe, also in the Caspian, the Black Sea, and the Mediterranean, ascending the rivers in great numbers to spawn.

*Caviare*, which forms an important article of commerce, consists of the roe of different species of this fish, cleaned, washed with vinegar, salted, dried, and then pressed into small cakes, or packed in kegs. Russian caviare, from the Black and Caspian Seas, is considered the best. Much caviare is also prepared on the shores of the Lower Danube. That furnished by the Sterlet (*Acipenser ruthenus*) is so superior that, according to Cuvier, it is reserved for the imperial court of Russia.

*Isinglass*, another product from these fish, is prepared from their air bladders. This substance owes its commercial value to its extremely delicate fibres, which operate mechanically in the clarification of white wines and malt liquors. It is also much employed in cookery. Russian isinglass is preferred to that from Hungary and Germany. The skin also of the sturgeon produces the leather known as shagreen, used to cover the cases of mathematical and philosophical instruments, and of spectacles.

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## *PRODUCTS OF THE SUB-KINGDOM MOLLUSCA.*

Mollusca (Latin, *mollis*, soft).—Soft-bodied, invertebrated animals, devoid of an internal bony skeleton, having a gangliated nervous system, the ganglia, or knots of nervous matter, being irregularly dispersed in different parts of the

body. They have a distinct pulmonary or branchial circulation, white or bluish blood, and, in many cases, a shell covering, in which the animal resides. This is secreted by the margin of a peculiar organ termed the mantle, or an external fold of the skin reflected over the body. Many of the lowest and some of the highest of the mollusca are naked, or a horny and testaceous rudiment of a shell is developed, but remains concealed beneath the substance of the mantle. When, however, the shell is so much enlarged that the contracted animal finds shelter within or beneath it, then the mollusc is termed testaceous (Latin, *testa*, a shell). We shall confine our notes to the testaceous mollusca, as, commercially, they are the most valuable. The following are the chief classes of the mollusca :—

1. *Cephalopoda*, or *headfooted* (Greek, *kephale* and *pous*, a foot), having the head well developed, protruding from the mantle, and furnished with tentacula, serving for the seizure of food and for crawling. Examples : nautilus and cuttle-fish.

2. *Gasteropoda*, or *belly-footed* (Greek, *gaster*, the belly), crawling by means of a broad muscular disc on the lower surface of the body, which serves as a substitute for legs. Examples : *Helix hortensis*, the garden snail ; *Lymnœa stagnalis*, the pond snail ; and *Limax agrestis*, the field slug.

3. *Pteropoda*, or *wing-footed* (Greek, *pteron*, a wing), comprehending a few molluscs which have a natatory winglike expansion on each side of the head. They are naked, or provided with a delicate univalved shell. Example : *Clio borealis.*

Most of the species of the class *Pteropoda* are fossil, but a great many are still found in existing seas, living near the surface.

The *Clio borealis* forms the food of the whalebone whale. It is an inch long, uses its light shell as a boat, its winglike

fins as oars, and so navigates, in countless numbers, the tranquil surface of the arctic seas.

4. *Conchifera* or *shell-carriers* (Latin, *concha*, a shell, and *fero*, I carry), including all the bivalved molluscs not *Brachoipods*. Examples : oyster, mussel, and pearl oyster.

5. *Brachiopoda*, or *arm-footed* (Greek, *brachion*, an arm).—Bivalves devoid of locomotive power, and attaching themselves to foreign bodies : they are furnished with two long ciliated arms developed from the sides of the mouth, which, by producing currents, bring food to the animal. Examples : *Terebratula* and *Lingula*.

## I.—DYES.

Some of the mollusca furnish dyes and pigments. The *Murex* yields various shades of purple and crimson. The celebrated Tyrian purple was formerly obtained from *Murex trunculus*. The cuttle fish (*Sepia officinalis*) which clouds the water by ejecting from its ink-bag a deep black fluid, thus effectually concealing itself, supplies the well-known pigment, *sepia*, of a deep brown-black colour; and a calcareous spongy plate, found in the same animal, is used as a substitute for emery or sand paper, and as a dentifrice.

## II.—SHELLS.

The beautiful variety of form and colour in shells has in all ages attracted notice. Among savages shells are used for personal adornment, and made into domestic utensils, such as knives, spoons, drinking-cups, fish-hooks, and even razors. The wampum belts of some of the North American tribes are made of shells. A small species of white glossy shell, called cowry (*Cypræa moneta*), abundant in the Asiatic and African shores, is used as money in small payments in India and throughout extensive districts in Africa, 100 being

equivalent to one penny. The same cowries are converted into a glaze for earthenware and an enamel for clock faces. The thin inner layers of a large flat bivalve (*Placuna placenta*) found in the Chinese sea, remarkable for their transparency and the absence of the nacreous or pearly layer within, are used by the Chinese for windows instead of glass. In Roman Catholic countries clam shells form receptacles for holy water; while some, perfectly white, are cut up for arm-rings and other ornaments. The *Turbinella*, or chank shell of India, fished up by divers in the Gulf of Manaar, on the north-west coast of Ceylon, is exported to India, where it is sawn into rings of various sizes, and worn on the arms, legs, fingers, and toes, by the Hindoos. The demand for these shells is caused by the religious rites of the Hindoos, and some choice specimens of them are valued at their weight in gold. The helmet shell (*Cassis*) supplies pieces large enough for umbrella handles, and the nacreous or inner layers of this shell, and other species, are exquisitely sculptured by Italian artists in imitation of antique cameos, and employed for rings, brooches, pins, bracelets, and other ornaments.

The *byssus*, or fasciculus of shining semi-transparent horny or silky filaments, by which many kinds of bivalves attach themselves to rocks, is in the large *Pinna* or wing-shell, so much developed that, by the natives of Sicily it is manufactured into gloves, socks, and caps, of a beautiful brownish colour. These are valuable as objects of curiosity, but too expensive for general use, the price of a pair of gloves or stockings being a fancy one, much above that charged in general for these useful articles of attire.

The large proportion of lime in shells renders them useful in making cement and as a fertiliser of the soil; hence shell-sand, the product of their natural crumbling on sea shores, is employed in improving heavy loams and

clayey or peaty soils. Mixed with any soil deficient in lime, shell-sand exercises a beneficial influence.

If we look at shell we shall find it to consist of three layers, viz., one external and rough, a medium layer consisting of delicate super-imposed laminæ of polygonal prisms, and an internal and shining one called the nacre, which is composed of a series of extremely delicate deposits, unequal in size and extent, and therefore imbricated in their position on each other, their margins presenting a series of lines with waved edges. These wrinkles, or furrows, which are of microscopic proximity and minuteness, decompose the rays of light, and produce that beautiful iridescent play of colours visible on the surface of the shell. It is this nacreous lustre which renders shells so capable of being applied to ornamental purposes, and gives to them their principal commercial importance.

The brilliancy of the colours reflected depends on the thinness of the laminæ of the nacre. Where the laminæ are thick, a dull white appearance only is visible, as in the oyster. Sometimes the external layers covering the nacre are rubbed off by natural causes, as in the case of shells which have been subjected to the roll of the waves on the sea-shore, where quantities may be found having the bright and iridescent nacreous surface exposed, but more or less injured; generally, however, these outer layers are removed artificially with a knife, and the shell is polished. This nacreous layer is the well-known mother-of-pearl, and shells having it in the greatest abundance are called pearl shells, such as the sea-ears (*Haliotis*) and a large species of top-shell (*Surbo marmoratus*, L.) Mother-of-pearl, in consequence of its lamellar structure, admits of being split into laminæ; or it is cut, without being slit, into square, angular, or circular pieces, which are employed extensively in the arts, particularly in inlaid work and in the manufacture of knife and razor-handles, buttons, snuff-boxes, and toys. Cut

into the form of leaves, flowers, and other devices, it forms a favourite material for ornamenting *papier-maché*—a name given to articles manufactured from paper pulp, which is moulded into varied forms, and rendered as hard as wood by being dried in an oven.

The most valuable shells in commerce are, however those which form the nacre into the fine, compact, concentric layers called pearls. These pearls are sometimes found free within the lobes of the mantle, but most frequently adhere to the nacreous coat of the shell. The species which produces the largest and most valuable pearls is the

PEARL OYSTER (*Meleagrina margaritifera*, L.)—The most notable pearl fisheries are those on the western coast of Ceylon; at the Bahrein Islands in the Gulf of Persia; at Tuticoreen, on the coast of Coromandel; off St. Margarita, or Pearl Islands, in the West Indies; in some places on the coast of Columbia; and in the Bay of Panamá in the Pacific. Very large and beautiful pearls, too, are said to have been found recently on the peninsula of California. The fisheries in the Persian Gulf, and on the Cingalese coast, give employment to many boats, divers, and other people, and yield a large revenue.

The value of pearls depends upon their size, purity, and lustre. The best are spherical, free from spot or stain, and have a clear, bright, white or yellowish-white, or bluish colour, with a peculiar lustre or iridescence. They vary in size—some not bigger than small shot, and others as large as a pea or bean. When pearls dwindle to the size of small shot, they are called seed-pearls, and are then of little value. "A handsome necklace of Ceylon pearls, as large as peas, is worth from £170 to £300; and one of pearls the size of peppercorns may be had for £15." * The largest and most

* See *Pearls*, "Dictionary of Commerce." By J. R. McCulloch. Also Journal of the Society of Arts, No. 896, vol. xviii.

valuable pearl of which we have any authentic account was purchased by Tavernier, at Catifa, in Arabia—a fishery famous in the days of Pliny—for the enormous sum of £10,000. It was pear-shaped, two inches in length, and half an inch in diameter, and is now the property of the Shah of Persia. The finest pearls generally pass under the name of "oriental pearls;" and those with less lustre and beauty, even if they do come from the East Indies, are called "occidental pearls."

Pearls are most abundant in the pearl oyster, and appear to be the product of a disease, caused by the introduction of foreign bodies within the shell. A pearl, if cut through, will generally show a nucleus, formed by a grain of sand or some other foreign body, around which the nacreous matter has accumulated in concentric deposits, instead of being spread in the usually horizontal laminæ on the inside of the shell. The Chinese are acquainted with this fact, and are in the habit of producing pearly deposits artificially, on the images of Buddha and other objects, by placing them within mussels (*Unio plicatus*), which are then thrown back into the river, and after a while retaken, and the image removed, which has thus become coated with pearl. In the British and South Kensington Museums examples may be seen of images and other objects which have obtained their pearly coating in this way.

The value of pearls has been greatly depreciated in modern times through successful imitation. The spurious glass and wax pearls now made in Paris, Venice, Nuremberg, and Bohemia, have much diminished the trade in real pearls. The best imitations were first made by a French bead-maker named Jacquin. The water in which the fish called the bleak (*Cyprinus alburnus*) is washed, is filled with powdery particles, which shine with a pearly lustre. Jacquin noticed this; he called this powder "essence

of pearl," or "*essence d'orient*," and succeeded in covering the inside of glass beads with it, thus producing a most admirable spurious glass pearl. A considerable trade is done with spurious pearls on the coasts of Senegambia, Guinea, and Congo, and the adjacent islands, where they are indispensable goods for the transaction of business with the natives.

## III.—EDIBLE SPECIES.

OYSTER (*Ostrea edulis*).—Vast beds of this mollusc are planted and tended with great care. The oyster culture is carried on at Colchester and other places in England, and on the coasts of France. The oysters are laid in beds, in creeks near the shore, where in two or three years they grow to a considerable size, and acquire a flavour superior to that of uncultivated oysters. For reasons not clearly explained, there has been an increasing scarcity in the oyster supply. The Whitstable native, the choicest of all kinds, has risen from the retail price of sixpence to three and four shillings the dozen. Inferior oysters have been brought to market, new beds have been dredged, and no pains spared to renovate the industry, with some measure of success. Immense numbers have come from America and foreign parts to fill the void.

MUSSEL (*Mytilus edulis*).—This is another popular mollusc, not so digestible as the oyster, but nevertheless in considerable demand as human food, and largely employed as bait for whiting, haddock, and cod. We have also the COCKLE (*Cardium edule*), PERIWINKLE (*Littorina littorea*), WHELK (*Buccinum undatum*), and the ORMOND WHELK (*Fusus antiquus*), with which our markets are abundantly supplied.

## PRODUCTS OF THE SUB-KINGDOM ANNULOSA.

*Annulosa* (Latin, *annulus*, a ring), a name given to the third great division of the animal kingdom. The body, in *Annulosa* generally, presents a symmetrical form, and consists of a series of rings or segments; the nervous system is a double nervous thread, which extends along the body at its lower side, and is united at certain distances by double "ganglia," or knots, whence nerves are given off to the members. In the group *Annuloida*, the body is ringed and devoid of limbs, whilst in the *Articulata* it is composed of movable pieces, and the limbs are jointed.

The following are the chief classes of the Annulosa:—

1. *Annelida* (Latin, *annullus*, a little ring), animals having bodies soft and pliable, more or less cylindrical, and formed of a great number of small rings. Examples: earthworm and leech.

2. *Crustacea* (Latin, *crusta*, a hard covering), having an articulated, hard shelly case or covering, in which the softer parts of the body are contained. Examples: crab, lobster, &c.

3. *Arachnida* (Greek, *arachne*, a spider), having the head and thorax confluent with each other, and the body consequently consisting of only two segments, with eight legs, and smooth eyes. Examples: spider and scorpion.

4. *Insecta* (Latin, *in*, into, and *seco*, I cut), including those animals having an insected or divided appearance of the body into three well-marked portions, called respectively the head, thorax, and abdomen. Six legs are articulated with the thorax. Examples: bee, moth, and beetle.

In the first class, *Annelida*, we have one species of very considerable value in commerce, the

LEECH (*Hirudo medicinalis*, L.)—An abranchiate red-blooded worm, provided with a circular disc or sucker, at

either extremity of the body. The oval aperture or mouth, is formed of three pairs of cartilaginous jaws, each armed with two rows of very fine teeth, and disposed in such a manner that they form three radii of a circle. This apparatus enables the leech so to penetrate the skin as to ensure a ready flow of blood without causing a dangerous wound. Leeches are found in pools and marshes in England, but principally on the Continent, especially in Portugal, the south of France, Germany, Hungary, and Russia. The greatest quantities come through Pesth and Vienna, from Hungary. Most of the leeches used in England are imported from Hamburg, whither they are sent from the lakes of Pomerania and Brandenburg, and from the province of Posen in Prussia.

Leeches are taken by men, who wade into the pools with naked legs, to which the leeches fasten. The men then leave the water, and remove them before their bites become injurious. Leeches are sent over in bags, or more frequently in small tubs, closed with stout canvas to allow a free passage of air. Each tub usually contains about 2000 leeches. Dr. Pereira states, in his Pharmacopœia, that "four principal leech dealers in London imported on the average 600,000 leeches monthly, or 7,200,000 annually." The consumption of leeches in France is much more extensive than in England.

The second class, *Crustacea*, furnishes several species which are used as food—as crabs, lobsters, crayfish, prawns, and shrimps, each of several varieties. Prawns and shrimps of fine quality are taken in hand nets on every low and sandy shore of our coast. We depend upon Norway and other places for half the supply of our largest lobsters, cray fish, and crabs, but there is reason to believe that if we trusted less to chance captures by our fishermen, and cultivated our lobster grounds as diligently as the Nor-

wegians theirs, we might double the numbers brought to market.

The third class, *Arachnida*, is of no commercial value.

The fourth class, *Insecta*, is pre-eminent over the others in the number of individuals, and in their beautiful forms, colours, and transformations. Its members are in the highest degree valuable to man, furnishing him with unlimited supplies of honey, wax, silk, and dyeing materials. The following are the most important insects, regarded from a commercial point of view.

The SILKWORM MOTH (*Bombyx mori*) belongs to the family *Bombycidæ*, a section of the nocturnal lepidoptera or moths. It has short plumose antennæ, a thick short body, stout legs, and white wings, with two or three dark lines stretching across them parallel to the margin. It lays its eggs, which are of a greyish tint, on the leaves of the mulberry tree (*Morus alba*) upon which the larva feeds. These larvæ form the cocoons from which the silk is procured. The eggs may be preserved a long time without deteriorating, provided they are kept free from damp, and not too many in the same packet. The eggs in this state are called by the silk cultivators' seed.

The larvæ when first hatched are a quarter of an inch long and of a dark colour, and the first care after their birth is to separate them from their shells, and place them on "hurdles" where they may find appropriate food. For this purpose, a paper perforated with holes and covered with mulberry-leaves is spread over the basket in which the larvæ are placed, and in passing through the holes to get at the mulberry leaves, they free themselves from their shells. The silkworm remains in the larva or grub state about thirty-four days, during which time it moults or changes its skin four times, increasing in size and voracity with every moult, and when fully grown is about three inches in length.

The caterpillar now stops eating, betakes itself to some convenient spot where, after spinning a few threads in various directions, it suspends itself in the midst of them, and by continually twisting its body, it gradually envelopes itself in a thick, silken, oval-shaped cocoon. The silk is a secretion of a pair of tubes called *sericteria*, which terminate in a prominent pore or spinneret on the under lip of the caterpillar. The two fine filaments from the *sericteria* are glued together by another secretion from a small gland, so that the apparently single silken thread proceeding from the caterpillar, which forms the cocoon, is in reality double. Whilst spinning the cocoon, which is usually completed in five days, the larva decreases in bulk, casts its skin, becomes torpid, and ultimately assumes the chrysalis form in the interior of the cocoon.

The cocoons, when completed, are thrown into warm water, which dissolves the glutinous matter that causes the threads to adhere, and separates them. The end of the thread is then found, and placed upon a reel; the silk is wound off the cocoon, and formed into what are called hanks. When this is carefully done, the silken thread obtained from a single cocoon is sometimes from 750 to 1150 feet long, or of an average length of 300 yards. Twelve pounds of cocoons yield one pound of raw silk. About one ounce of silkworms' eggs will produce 100 lbs. of cocoons; 16 lbs. of mulberry leaves are food sufficient for the production of 1 lb. of cocoons: and each mulberry tree yields about 100 lbs. of leaves. These data afford the reader the means of calculating the number of insects, eggs, trees, and leaves, necessary for the production of the quantity of silk consumed in the United Kingdom in any one year as given in the Government Trade Returns.

The art of rearing silkworms, of unravelling the threads spun by them, and manufacturing those threads into articles

of dress and ornament, seems to have been first practised by the Chinese. In China, Japan, and India, silk has formed, from time immemorial, one of the chief objects of cultivation and manufacture. The silkworm moth and the mulberry tree are, in fact, both natives of China, and a great portion of our supplies of silk are still derived from that country. There was a time when silk, now so abundant, was valued in Rome at its weight in gold, and the Emperor Aurelian refused his empress a robe of it on account of its dearness. At the period when our ancestors were naked savages—2000 years ago—the Chinese peasantry, amounting in some provinces to millions in number, were clothed in silk.

From China, the cultivation of silk extended to Hindostan, and thence to Europe, in the reign of the Roman emperor Justinian, about the middle of the 6th century. From the 6th to the 12th centuries the culture of silk was confined to Greece, particularly to the Peloponnesus, where it spread so much that this part of Greece derived its modern name Morea (Latin, *morus*, a mulberry) from that circumstance. From Greece, silk cultivation spread into Sicily, Italy, Spain, and finally France. The French commenced its culture in 1564, under the auspices of Henry IV., and the raising of raw silk and its manufacture now forms a very considerable proportion of the French trade. We have not space for further detail of the progress of the silk manufacture.

At present the United Kingdom is supplied with the raw material for manufacture principally from China, the East Indies, the Levant, France, and Italy. Of Chinese silks the best comes from the provinces of Nankin and Tsekiang in Eastern China. Silk of an inferior character is received from Southern China, through Canton. The principal ports from which we receive East Indian silk are Calcutta and Bombay. The exports from these places amount to 10,000

cwts. annually. Anatolia and Syria produce much good silk, principally around Damascus and Beyruth; this goes chiefly to Western Europe, *viâ* Aleppo, Smyrna, and Constantinople. A great deal of Persian and Armenian silk is brought by caravans from Asia, by Bassora, Bagdad, and Damascus, to the ports of the Levant, and goes by the name of silk of the Levant. This name also includes all the silk produced in Turkey, the Morea, and in the Archipelago, and brought into commerce through Gallipoli and Salonica. As the breeding of silkworms only prospers in warm climates, silk culture is confined in Europe to Italy, the south of France, and Spain. There is also considerable silk cultivation on the southern slopes of the Alps, in Tyrol and Illyria, and within the last twenty years successful attempts at silk culture have been made in Bavaria and Lower Austria.

Although the climate of England is too cold to enable us to rear the silkworm, we are able to manufacture the silk, which increases the value of the raw material about threefold. The principal seats of the English silk manufacture are :—For broad silks, Spitalfields, Manchester, Macclesfield, Glasgow, Paisley, and Dublin; for crapes, Norfolk, Suffolk, Essex, Middlesex, and Somerset; for handkerchiefs, Manchester, Macclesfield, Paisley, and Glasgow; for ribands, Coventry; for hosiery, Derby; and for mixed goods, Norwich, Manchester, Paisley, and Dublin. The exports of British manufactured silks are chiefly to the United States and the Colonies. We also ship silks extensively to South America, Germany, Belgium, and even India and France. Silk culture in France has suffered much, and more than once been threatened with extinction through the ravages of a fungoid disease; every worm attacked becoming a centre of rapid infection. In order to avert a great national calamity, new seed and other varieties of worms have been diligently sought in the East. The most promising new introduction

is that of the Tusser, an Indian worm, which spins a strong but rather coarse thread, of which the natives consume a quarter of a million pounds yearly in the fabrication of the Tusser cloth. The worm feeds on various plants, and spins ten times more silk than the common silk-worm. The Chinese wild silk, or moonga, of which it is calculated that three quarters of a million pounds are worked up every year in China, seems to be a resource equal to present and prospective demands. The United Kingdom has been saved from loss, since the silk is received only as cocoons or as the thrown silk of Italy, and the area of supply has so widened as to remove dependence on France. Meanwhile new vitality has been given to what was always a languid British industry, by appliances to utilise the floss formerly thrown away as waste, but now become of an importance equal to the whole previous silk manufacture. Numerous other silk worms are known, their produce mostly supplying native local wants. Two of them, however, the Cynthia of China and the Arrindia, have reached Europe, the first feeding on the oak leaf and giving two crops of cocoons in the year, and the second feeding on the castor oil plant. Both give good silk, but the cocoons have the disadvantage of being open at the end, and when reeling, fill with water and sink instead of float, causing the thread constantly to break.

Next to the silkworm moth the Honey Bee (*Apis mellifica*) is the most useful insect to man. This insect belongs to the order *Hymenoptera* (membrane-winged), an order characterised in most of the genera by the presence of a sting. The habits of the honey bee are replete with interest, arising from its social economy and from the separation of the individuals into three communities based on sexual modification, viz., the queens, or prolific females; the workers, or barren females; and the drones, or males.

The hive bee or honey bee is distinguished from the other species of *Apis* by having the femora of the posterior pair of legs furnished with a smooth and concave plate on the outer surface, which, fringed with hair, forms a basket adapted for the conveyance of pollen. A swarm of bees consists generally of about 6000 individuals, of which about one-thirtieth part are males, the rest females, and of these one only is for the most part prolific, called the "queen." The body of the queen bee is longer, her colours brighter, and her head smaller than these parts in the other bees, and her sting is curved. The male bees or drones have no stings; their body is shorter and thicker. The workers have a straight sting, but as their growth is arrested before the full development of all their organs, they are smaller than either the queen or the drones, and their colours are less bright. The honey bee in its natural state generally constructs its nest in hollow trees, but throughout Europe it is now rarely found except under domestication.

The comb consists of beautiful hexagonal cells, placed end to end in such a manner that each cell is closed by three waxen plates, each of which also assists in completing one of the cells of the other side of the comb. The whole duty of the construction of the comb and the care of the young devolves upon the workers, whose incessant activity has rendered them the symbol of industry.

It is a remarkable fact that we derive the greater part of our knowledge of the economy and habits of the hive bee from the labours of a blind man. The elder Huber lost his sight when only seventeen years of age, but by means of glass hives, variously constructed, he was enabled, through the aid of his wife, to become acquainted with all that was going on in them, and from her faithful recital of what she saw, together with the aid of an untiring investigator, M. Burnens, he amassed the material for his celebrated work.

In the construction of the comb the bees take hold of each other, and suspending themselves in clusters, which consist of a series of festoons or garlands crossing in all directions, remain immovable for about twenty-four hours, during which time the wax is secreted in the form of thin plates from between the scales of their bodies. One of the bees makes its way to the roof of the hive, and detaching its plates of wax in succession from the abdomen with the hind legs, works them up with the tongue into the material which forms the comb; this bee is followed by others, which carry on the work. As soon as a few cells are thus prepared, the queen bee begins to exude her eggs. The first eggs develop into workers, the next produce the drones and also the queens. The eggs are deposited in the cells, and in five days the maggot is hatched. The sole employment of the queen bee is the laying of these eggs, and as only one is deposited in each cell, this occupies her almost incessantly. The queen, when thus engaged, is accompanied by a guard of twelve workers, who clear the way before her, and feed her when exhausted, always with the utmost courtesy turning their faces towards her, and when she rests from her labour, approaching her with humility. She lays "workers" eggs for eleven months, and afterward those which produce drones. As soon as this change has taken place, the workers begin to construct royal cells, in which, without discontinuing to lay the drones' eggs, the queen deposits, here and there, about once in three days, an egg which is destined to produce a queen. The workers' eggs hatch in a few days, and produce little white maggots, which immediately open their mouths to be fed; these the workers attend to with untiring assiduity. In six days each maggot fills up its cell, it is then roofed in by the workers, spins a silken cocoon, and becomes a chrysalis, and on the twenty-first day it comes forth a perfect bee. The drones

emerge on the twenty-fifth day, and the queens on the sixteenth."*

As for nearly a year the queen bee does not lay any eggs destined to become queens, if any evil befalls her during that time the hive is left without a queen. Her loss or death stops the work of the hive, and unless another queen is provided, the bees either join another hive or perish from inanition. After about two days, however, the bees generally decide to provide themselves with a queen, and this state of anarchy subsides. A few of the workers repair to the cells in which their eggs are deposited, three of these cells are made into one, a single egg being allowed to remain in it. When this egg is hatched, the maggot is fed with a peculiarly nutritive food, called "royal bee bread," which is only given to maggots destined to produce queens. Work is now resumed over the whole hive, and goes on as briskly as before; on the sixteenth day the egg produces a queen, whose appearance is hailed with every demonstration of delight, and who at once assumes sovereignty over the hive.

If the old queen should survive, and the young queens emerge from the eggs last deposited by the old queen under ordinary circumstances, the workers do not allow them instant liberty, as severe battles would take place between them and the reigning queen; they are therefore kept prisoners in the cell, and fed through a small hole which is made in the ceiling of their cell, through which these captive queens thrust their tongues and receive their food from the workers. In this state of confinement the young queen bee utters a low complaining note, which has been compared to singing. When the old queen finds one of these captives, she uses every effort to tear open the cell and destroy her rival; the workers prevent this, pulling her away by the legs

* "Familiar Introduction to the Study of Insects." By Edward Newman, F.L.S.

and wings. After repeated attempts to penetrate the cells and destroy her royal progeny, the old queen becomes infuriated, communicates her agitation to a portion of her subjects, who, together with her, rush out of the hive and seek a new home. The queen and accompanying swarm generally fly to some neighbouring resting-place, are observed by the owner, captured, placed in a new hive, and a new colony is at once commenced. The labourers that remain pay particular attention to the young imprisoned queens, and these, as they are freed from confinement, successively lead off fresh swarms, if the hive be not enlarged. Each swarm contains not only the recently-hatched young bees, but also a portion of the old inhabitants. After the hive has sent off three or four swarms, there are not enough bees left to guard the royal cells. The young queens, consequently, escape two or three at a time; a battle ensues amongst them, and the strongest remains queen of the hive, after destroying all the royal larvæ and pupæ that remain.

According to Huber there are two varieties of working bees. The nurse-bees, which continue in the hive, whose office is to build the comb and feed the larvæ; and the collecting bees, which fly abroad and bring back to the hive the pollen and honey which they collect. This pollen is formed into little pellets, and packed on the hind legs in the receptacle formed there for this object. Honey is also swallowed by the bee, which passes into the crop, where it accumulates as in a reservoir, and on the return of the bee to the hive is poured into a honey cell. When a pollen-laden bee arrives at the hive, she puts her two hind legs into a cell, and brushes off the pellets with the intermediate pair. These pellets are kneaded into a paste at the bottom of the cell. The softened kneaded pollen thus packed away is called "bee-bread." Besides honey and pollen, bees collect a gum-

resin called by Pliny "propolis," principally from the balsamic buds of the horse chestnut, birch, and poplar. This is used in closing up crevices in their hives, and in strengthening the margins of the cells of the comb.

*Honey* and *Wax* are two valuable commercial articles for which we are indebted to the labours of the hive bee. Bees' wax is prepared by melting the comb in boiling water after the honey has been removed; the melted wax is then strained and cast into cakes, which have a pale yellow colour and a pleasant odour.

White bees' wax is formed by exposing the yellow wax in thin slices or ribands to light, air, and moisture, and then re-melting and forming it into cakes. Wax candles are made by suspending the wicks upon a hoop over a cauldron of melted wax, which is successively poured over them from a ladle till they have acquired the proper size, so that the candle consists of a series of layers of wax; the upper end is then shaped and the lower cut off. Wax is also much used in taking casts or moulds, and as an ingredient in cerates and ointments. It is of great value in anatomy in representing normal or diseased structures. Most of our anatomical museums have very instructive preparations made of this substance.

In addition to the large amount of wax, the annual produce of our own hives, considerable quantities are received from Canada. Africa sends us heavy supplies, and large shipments come also from Madras. California has proved to be the paradise of bees, with such an amazing production of honey, that the country bids fair to become the one hive to which the commercial world may resort. Bee keepers lay the foundation of the combs in wax; the insects take to it readily, having then only to construct the cell walls.

Honey is abundantly produced in the United Kingdom. Its flavour varies according to the nature of the flowers from

which it is collected. Thus the honeys of Crete, Minorca, and Narbonne are flavoured with rosemary, which there grows profusely; the honey from Provence is flavoured with lavender; and the delicious taste and perfume of the honey from Cuba is due to the presence of neroli oil, obtained by the bees from the orange flowers which abound there. Some poisonous flowers are even said to communicate to honey their injurious qualities. An instance is recorded by Xenophon of the Greek soldiers becoming intoxicated by honey gathered from the rhododendron.

BLISTER FLY (*Cantharis vesicatoria*).—This is a small coleopterous insect about three-fourths of an inch long, of a nauseous odour and a brilliant golden green colour. These insects secrete in their bodies a principle which has the power of vesicating or blistering the human skin when applied. For this purpose the beetle is reduced to powder, which, mixed with ointment or lard, is spread thinly upon a piece of leather, and then applied to the part intended to be blistered. The blister fly is found on a variety of shrubs in Spain, Italy, and France, and has been taken occasionally in England. We now receive it principally from Astracan and Sicily. It still retains its usual commercial name of Spanish flies. In some years as many as twelve tons of these insects have been shipped from Sicily. Some idea of the immense number destroyed to form that amount may be obtained from the fact that fifty of them scarcely weigh a drachm.

COCHINEAL (*Coccus cacti*).—This valuable insect was first introduced into Europe in 1523 from Mexico. It belongs to the order of insects called *Hemiptera*, or half-winged. The portion towards the base of each wing is tougher or more coriaceous than the other part of the wing, which is membranous.

The culture of the cochineal insect has extended from

the New World to the Old, being produced in various parts of Europe, and tried, though without much commercial success, in India, Java, and Algiers. The cochineal insect is small, rugose, and of a deep mulberry colour. It feeds on several species of cactus. These insects are scraped from the plants into bags, killed by boiling water, and then dried in the sun. Those are preferred which are plump, of a silvery appearance, and which yield when rubbed to powder a brilliant crimson. It is estimated that 70,000 of these minute insects are necessary to make a single pound of cochineal. With these data it would be an arithmetical feat to calculate the billions of the tiny scale insects that go to make up the thousands of tons of cochineal which our tastes demand for this brilliant dye.

The red colouring matters known by the names of *carmine* and *lake* are made from cochineal. Cochineal is used for dyeing scarlet, and is employed chiefly for woollen goods. The dye is obtained by fixing the colouring matter of the insect by a mordant of alumina and oxide of tin, and exalting the colour by the action of super-tartrate of potash.

LAC INSECT (*Coccus lacca*).—The habits and economy of this insect are much the same as those of the cochineal. The lac insect attaches itself to the bark of trees abounding in milky juice—such as the *Ficus Indica* or Indian fig, and the *Ficus religiosa* or Banyan fig—punctures the bark, and causes an exudation of the milky juice; this eventually surrounds the lac insect, her eggs, and larva, producing an irregular resinous-looking brown mass on the branch which it encircles. The commercial varieties of Lac are *stick lac*, which is the substance in its natural state investing the small twigs of the tree; seed lac, the same substance broken off in small pieces from the twigs, and *shell lac*, consisting of the substance melted and formed into thin cakes. Seed lac and shell lac are the resin left after the dye has been ex-

tracted from the stick lac. Lac dye and lac lake are two preparations of the colouring matter of stick lac, imported in small cubic cakes from the East Indies. The colouring matter of these dyes much resembles cochineal, for which it is largely substituted. Nearly half of our imports from Bengal of lac dyes and shell, which together somewhat exceed our trade in cochineal, are re-exported from England to Italy, Germany, and other parts of Europe.

Lac is mainly consumed in the manufacture of dye stuffs, sealing-wax, and of certain varnishes and lacquers. Red sealing-wax has its colour communicated by vermilion; white sealing-wax is made with bleached gum lac; black sealing-wax is a mixture of shell lac and ivory black; and blue sealing-wax is made by colouring the shell lac with smalt or verditer. To make golden sealing-wax, powdered yellow mica is mixed with the shell-lac.

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## *PRODUCTS OF THE SUB-KINGDOM CŒLENTERATA.*

*Cœlenteratà* (Greek, *koile*, a hollow, and *enteron*, an intestine) is the fourth primary division of the animal kingdom, and includes all those animals in which the mouth and stomach are not separate from the rest of the cavity of the body. The substance of the body consists of two membranes, which are generally provided with cilia, and contain peculiar urticating organs, termed "thread-cells." A nervous system is absent in most. They have been subdivided into the following classes:—

1. *Hydrozoa*, in which the wall of the digestive sac is not separated from that of the general cavity, and the reproductive organs are external. Examples: hydra or water-polyp, and jelly-fishes. The latter are called also sea-nettles because leaving, when touched, a disagreeable

sensation, like the sting of a nettle. They have an extremely soft, gelatinous structure, and float and swim in the water by alternate contractions and dilatations of the body.

2. *Actinozoa*, in which the wall of the digestive sac is separated from that of the general cavity, and the reproductive organs are internal. Examples: sea anemone, sea-pen, sea-fan, red-coral, and coral-polyps.

The latter class only is of commercial importance; although the ovaries of the Echinus were esteemed a delicacy by the Romans, and are still prized for food along the borders of the Mediterranean.

RED CORAL (*Corallium rubrum*, L.)—This is a marine production, formed by numerous polyps in union with each other, called a polypidom. Recently taken, coral is covered with one continuous living membrane, in which are the polyp cells. These polyps produce the coral, a branched tree-like structure, beautifully red, and very hard, and for this reason much sought after for ornamental purposes. In places where good coral is obtained it forms an important article of commerce. It is abundant in various parts of the Mediterranean Sea. It occurs in the Red Sea, the Persian Gulf, and on the coasts of Spain, France, Corsica, Sardinia, and Sicily. Very fine coral is found between Tunis and Algiers, off the coast of Barbary, where the French and Italians carry on the coral fisheries. Other species of the genus have from time to time been dredged off Madeira and the Sandwich Isles.

Coral always grows perpendicularly on the surface of the rock to which it attaches itself, in whatever position the rock may be placed, and from eight to twelve inches in height. Coral requires from eight to ten years to arrive at its full growth. It is dredged up from depths varying from 10 to 1100 fathoms. Its value depends on its size, solidity, and the depth and brilliancy of its colour. Some of the corals

in the market are worth from eight to ten guineas an ounce, whilst other kinds will not fetch one shilling a pound.

Coral is made up into a variety of ornamental articles. The principal towns where it is worked are Marseilles, Genoa, Leghorn, Naples, and Trapani. In Persia, China, and Japan, coral ornaments, in the form of necklaces, bracelets, and rings, are still valued as highly as gold, and large quantities of them are manufactured in Naples for the Eastern market.

Stone Corals, under the name of brainstones, millepores, madrepores, harp corals, and cup corals, are well-known drawing-room and mantelpiece ornaments. When living, they were covered with fleshy matter, from which projected the polyps which give the peculiar markings to their surface. The fleshy mass was removed, and the coral was then bleached, or obtained its beautiful white colour by exposure to the air and sun. These corals occur in prodigious quantities in the South Pacific Ocean, where they form the reefs and islands so abundant there.

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## PRODUCTS OF THE SUB-KINGDOM PROTOZOA.

Protozoa, or first animals (Greek, *protos*, first, and *zoon*, an animal). Examples: Infusoria, or animalculæ developed in vegetable infusions, and sponges.

Sponge (*Spongia officinalis*, L.)—This organism is now acknowledged by naturalists as belonging to the animal world. A piece of sponge shows on its surface an indefinite number of minute holes, amongst which there are larger openings scattered. When alive and in the water, currents of water are seen to enter the smaller openings, which, after passing through the body of the sponge, are ejected out of the larger orifices. Nutritive matter is

conveyed by these currents into the body of the sponge, and fæcal matter is at the same time removed. A coating of living gelatinous matter is spread all over the fibres of the sponge, in consistence like the white of an egg. This runs away freely from the sponge when the latter is taken out of the water. Nothing then remains visible but the sponge, which is, in fact, the horny skeleton or structure formed by the labours of the animals constituting the gelatinous coating.

Sponges occur in all seas, from the equator to the poles, but they attain their greatest size and perfection in the tropics. They grow on anything which will serve them as a point of attachment, covering rocks, shells, seaweed, and even living animals. Thus, Dr. Johnson, in his "Natural History of British Sponges," mentions the case of a sponge which was found growing on the back of a living crab, and so large that it was "a burden apparently as disproportionate as was that of Atlas;" the creature not appearing at all to be inconvenienced, for it was "big with spawn, in a state nearly ready for laying. Indeed, the protection which the crab derived from the sponge might more than compensate for the hindrance thus opposed to its freedom and activity. When at rest, its prey might seek, without suspicion, the shelter afforded amid the thick branches of the sponge, and become easy captives; while, when in motion, scarcely an enemy could recognise it under such a guise, and the boldest might be startled at the sight of such a monster."

Several kinds of sponge come into the market, but the most valuable, and those also most in general use, are called Turkey and West India sponges. The tubes and orifices of the Turkey sponge are smaller than those of the West India variety; it is also more durable, and less easily torn. The Turkey sponge is obtained from the Mediterranean, where it grows on rocks and stones at the bottom

of the sea in masses from the size of an egg to that of a man's head. Our supplies are received from Cyprus and Candia, from the shores of Anatolia, and from several islands of the Grecian Archipelago, especially from the small island of Symis or Syme, whose inhabitants are said to be the best divers. The coast of Syria furnishes the finest toilette sponges, being four times the value of ordinary qualities. Inferior sponge, with a large-holed texture, called horse sponge, comes from the coasts of Barbary, Tunis, and Algiers. The coarsest sponges come principally from America. Very large ones absorbing a pail of water, and used for carriages, are obtained from the Bahama banks and the coast of Florida.

The property which sponge possesses, of absorbing water into its tubes and retaining it until squeezed out, renders it valuable for all purposes involving washing and cleansing.

# PART IV.

## COMMERCIAL PRODUCTS OF THE MINERAL KINGDOM.

### *RAW PRODUCE.*

I. Metals and Metalliferous Minerals.

Iron: *Magnetic iron ore, titaniferous iron ore, red hæmatite, brown hæmatite, spathic ores, clay ironstones, other ores. Process of smelting, puddling, &c.; steel, supply of iron.* Gold, silver, quicksilver, platinum, tin, copper, lead, zinc, aluminum, antimony, bismuth, cobalt, arsenic, manganese, chromium (*with their chief ores, uses, localities, &c.*)

II. Earthy Minerals.

(*a*) *Coals and allied substances.*

Coal: *Lignite, bituminous coal, steam coal, anthracite. Supply of coal.* Jet, amber, *naphtha, petroleum,* asphalt, mineral pitch.

(*b*) *Limestones, Limes, and Cements.*

Common limestone, ornamental limestones, and so-called marbles; marble, coral limestone, marl, calcareous sand, gypsum; *composition of limes, stuccoes, and cements.*

(*c*) *Siliceous and Felspathic Substances.*

Rock crystal, quartz, and flint; sandstones, paving, mill, and building stones; siliceous sands, rottenstone, Bath bricks, Tripoli powder, Bilin powder, berg-mehl, tellurine.

(*d*) *Igneous and Metamorphic Rocks.*

Granites: *Syenite*, mica, talc, asbestos, serpentine, basaltic rocks; *greenstone*, *whinstone*, *trap*, lava, obsidian, pumicestone, pozzuolano, and trass.

(*e*) *Clays and allied Substances.*

Common clay, yellow, brown, and blue; kaolin and petuntse, pipe clay, fire clays, *Stourbridge clay*, fuller's earth, red and yellow ochres, slates, hone stones.

(*f*) *Earths of Sodium*, *Potassium*, *Boron*, *Sulphur*, *&c.*

Common salt, rock salt, soda, *chlorine*, alum, natron, borax, saltpetre or nitre, cubic nitre, heavy spar, celestine, strontianite, fluor spar, sulphur, *sulphuric acid*, graphite or plumbago; mineral manures, *phosphates of lime.*

(*g*) *Precious Stones.*

1. Carbonaceous: diamond.
2. Aluminous: ruby, sapphire, emerald, topaz, corundum, garnet, beryl.
3. Siliceous: amethyst, cairngorm stone, opal, sardonyx, agate, chalcedony, carnelian, jasper, lapis-lazuli, turquoise.

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## I. *METALS.*

### IRON.

This indispensable metal is, in a variety of forms, almost universally diffused throughout the earth. It is of use in all the appliances of modern civilisation—in machinery of

every description, instruments, implements, and tools of all kinds; architecture and domestic fittings and utensils; conveyance, both inland and maritime; apparatus for warming, lighting, and water supply; and even in medicine, to impart renewed vigour to the failing human frame. It occurs in most geological formations, to which it contributes a great part of their colouring matter; it is found in spring and river waters; and it enters into the composition of both plants and animals. It is present, too, as the principal ingredient, in the extraordinary fragments called meteoric stones, and the spectroscope proves this ubiquitous metal to be a large constituent of worlds beyond our own. Iron can be melted and cast into moulds, softened, and hammered out into plates, drawn out into bars and wires, tempered to almost any degree of flexibility, hardened so as to scratch glass, and sharpened to the keenest cutting edge. In some of its *natural* forms iron is highly magnetic, but magnetism can also be communicated. Pure iron is white, or greyish-white, lustrous, soft, and tough, and it is one of the most infusible of metals (fusible at 3480° F.) Its specific gravity is 7.84. When beaten out it appears granular in structure; when drawn, fibrous; and to this latter peculiarity is attributed its extraordinary tenacity.

Metallic iron, as it occurs in meteoric stones, is usually alloyed with nickel and other metals, but its occurrence as terrestrial native iron is doubtful. There are many minerals containing iron, but of these only the oxides and carbonates are reduced by the smelter; they are magnetic iron or loadstone; specular and micaceous iron ores; the red and brown hæmatites; the spathose ore and the clay ironstones.

The maximum development of iron ores appears to be in the palæozoic rocks, the largest and richest deposits being contained in the Laurentian rocks of North America and Scandinavia; they are abundant in the Devonian rocks of

Germany and south-west of England. The Carboniferous system is especially marked by the presence of interstratified argillaceous carbonates both in America and Europe. The celebrated kidney ore of Cumberland is found in Permian strata, the Secondary rocks are rich in bedded deposits of ironstone, and the Tertiary series yields limonites.

*Magnetic iron ore*, or *Magnetite*, is the black oxide ($Fe_3O_4$ or $FeO + Fe_2O_3$), and contains 72.41 per cent. of iron. It occurs in many parts of the earth in immense masses, forming the substance of hills and even mountains, both in Scandinavia and in the Urals, and in some hills of Swedish Lapland, Mexico, and Styria. In Canada magnetite is found abundantly in the gneiss and crystalline limestones constituting the Laurentian rocks; it occurs in irregular beds, often of considerable thickness, in one instance as much as 200 feet. In the State of New York this mineral occupies the Valley of Adirondac and its neighbourhood for a mile in width and twenty miles in length. In our own country it occurs in Dartmoor, at Rosedale, and in Antrim; it is found also in New Jersey, Pennsylvania, Nova Scotia, and parts of the East Indies. This ore is not only the richest in pure metal, but furnishes also the finest qualities. It is remarkable, however, that some veins, without any apparent chemical difference, produce finer iron than others. The produce of the mines of Dannemora in Sweden is of the finest description, and is employed in the production of the highest class of steel. Magnetic iron ore occurs chiefly in veins and fissures in diorites or dolerites, or in interstratified masses in metamorphic rocks.

*Titaniferous iron ore* contains protoxide and peroxide of iron, titanic acid (an oxygen compound of the metal titanium), and magnesia in variable proportions. The bar iron or steel made from titaniferous iron ore possesses unusual

strength and a peculiar mottled appearance. This ore is chiefly employed with others to impart a high degree of toughness to the metal produced.

*Red hæmatite* is a sesquioxide of iron ($Fe_2O_3$) with seventy per cent. of iron. It is distinguished from the less rich brown hæmatite by its red streak, that of the latter mineral being brown in colour. Red hæmatite is known by special names, according to its different varieties :—

*Specular iron ore*, *oligiste*, or *iron glance*, is brilliant, hard, and distinctly crystallised. It is found in Elba and Brazil.

*Micaceous iron ore* is scaly, crystalline, loosely coherent, and similar to graphite in structure. It is met with in South Devon.

*Kidney ore* is a hard botryoidal variety, devoid of lustre, such as that of Cumberland.

*Red ochre* is a compact, earthy, and more or less clayey variety, and is usually employed in the preparation of red and yellow ochres and umbers.

Red hæmatite occurs abundantly in England and Wales, and, being rich, is much used for mixing with the poorer ores of the coal formations in the process of smelting. The red ore is worked in Cumberland, at Ulverstone, in Forest of Dean, Cornwall, North Wales, Ireland, Belgium, Nova Scotia, Elba, Sweden, Missouri, and the neighbourhood of Lake Superior.

*Brown iron ore* or *hæmatite* consists essentially of three equivalents of water united to two of peroxide of iron, or $2\ Fe_2O_3 + 3\ H_2O$, and is compact and earthy.

*Gothite* is another hydrated oxide ($Fe_2O_3 + H_2O$), but it is crystallised. Both minerals are usually included in the smelter's term "brown hæmatite," and, though resembling the red in outward appearance, are distinguished by their brown streak. Bog iron ores, and those deposited in the

beds of lakes by the action of infusorial life, belong to this group of iron ores.

Brown hæmatites are largely worked in the Carboniferous rocks of England and South Wales; in the Lias of Oxfordshire, Northamptonshire, and Yorkshire; in the Lower Greensand near Devizes, and in Buckinghamshire; in Oolitic strata in France, Bavaria, Wurtemburg, and Luxemburg; and in the Wealden rocks of the Boulonnais. Bog-iron ore is abundantly developed in North Germany, Sweden, Norway, Finland, and Canada.

*Siderite, spathose iron*, or *brown spar*, is a carbonate of the protoxide of iron ($FeO, CO_2$), or, commonly speaking, carbonate of iron. The spathic ores are sparry or crystalline, and are associated with varying quantities of carbonate of lime and of magnesia. Spathic ore, when pure, is white; but it becomes reddish on exposure to the air. It is particularly abundant in Styria, where the mountain Erzberg, near Eisenerz, is capped by the mineral to a thickness varying from 200 to 600 feet; in Carinthia and other parts of Austria; at Siegen, in the Stahlberg, or "steel mountain" (Rhenish Prussia); and in the United States (New York and Ohio). The principal English deposits are those of Weardale, in Durham; Exmoor, Devonshire; and Brendon Hill, in Somersetshire.

*Clay ironstone* is an amorphous argillaceous carbonate of iron, mixed with small quantities of lime and magnesia, and sometimes, as in the "black band," with bituminous matters. The poorest of the serviceable ores, they are, nevertheless, in Britain, the most important, furnishing nearly two-thirds of the total yield of iron. Being mostly connected with the Coal formations, they are cheaply worked, having in immediate proximity a plentiful supply of fuel and limestone for their reduction. There are many varieties—that called the "black band" being among the

most valuable, from the ease and cheapness with which the ore may be calcined, by burning it in heaps without any additional fuel.

The ores are extensively worked in South Wales, Monmouthshire, Shropshire, Staffordshire, Yorkshire, Derbyshire, Lanarkshire, Stirlingshire, County Antrim ; in Belgium, Silesia, United States, North China, Japan, India, Brazil, and Tasmania. Ireland has large deposits, which are not much worked. Clay ironstones are not confined to the Carboniferous rocks, but are extensively met with in the Lias, Oolite, and Wealden, and even among Tertiary rocks. Of this character are the rich iron district of Cleveland, in Yorkshire, and similar deposits in France.

*Iron pyrites*, *mundic*, the bisulphide of iron ($FeS_2$), is diffused through rocks of all ages, but the presence of sulphur makes it of little value for the production of iron. It is important, however, both directly as a source of sulphur and sulphuric acid, and indirectly in the immense number of the useful applications of this latter product. Pyrites sometimes contains gold, and it is then called *auriferous pyrites*. Wicklow, Cleveland, Bohemia, Spain, Portugal, and Norway possess very large quantities of this mineral.

*Phosphates of iron* are worked in Canada, and *silicates* in Switzerland.

The principal processes to which iron ores have to be subjected, in the preparation of iron and steel for manufacturing purposes are roasting and smelting, refining and puddling, cementation and tempering—varying with the nature of the ores. The roasting process—chiefly necessary for impure ores—gets rid of combustible matter, water, and carbonic acid. The smelting, conducted in large blast furnaces, disengages the metal from the oxygen and earths of the ores, and brings it into the marketable form of cast

iron, in pigs. This is really a carbide of iron, containing a considerable proportion of carbon, with small quantities of some other substances, such as silica and potash, derived either from the ores or the fuel. It is very brittle, and suitable only for castings; and according to its quality, it is grey iron, which is the best; mottled; or white, which is the worst. Refining, a re-melting of the metal with coke or charcoal, removes some of the carbon and silicon, and produces what is called fine metal. The puddling, which is carried on in a reverberatory furnace, disengages further quantities of these impurities, and makes the iron malleable, prepared in bars or sheets, as required. By cementation, or heating with charcoal, bar iron is made into blistered steel. From this, by welding, shear steel is made; and by re-melting and casting, the cheaper cast steel is obtained. Spathose pig-iron can be converted into steel without any intermediate processes. This is done in Styria and other parts of the Continent, and in Borneo. The produce is called natural steel, and is of very fine quality. Ordinary cast iron, annealed, called "run-steel," can sometimes be substituted for steel. The tempering of steel, to adapt it, as regards hardness and ductility, for its various purposes, is effected by the processes of re-heating and sudden cooling —the temperature being made to vary with the quality sought to be produced.

The manufacture of both iron and steel is constantly progressing, and inferior ores are being utilised by new processes in many places.

Middlesbro'-on-Tees affords a remarkable illustration of the sudden rise of a town through judicious employment of capital and superior technical knowledge in the iron trade.

The Thomas and Gilchrist process has revolutionised the trade.

## GOLD.

This noble metal is unaffected either by air or water, and is of great and almost universal use. In civilised countries it forms, as coin, the principal medium of exchange, besides being used in the form of gold-dust for a similar purpose among semi-barbarous nations; and from the richness of its colour and its imperishable nature, it enters very largely into the composition and ornamentation of such articles of utility and luxury as require to be both durable and beautiful. For all these purposes it is peculiarly fitted by its weight (sp. gr. 19.5) and its extraordinary malleability and ductility. In virtue of these latter qualities it can be hammered out into leaves of 282,000 to an inch, and a single grain can be extended into 500 feet of wire. Its natural softness can be corrected by a slight alloy of silver or copper, and in this state it is commonly employed.

Gold is more generally diffused than any other metal except iron, but not in all places in sufficient abundance to render its collection or extraction profitable. It occurs mostly native, being either pure or alloyed with silver, tellurium, and other metals; and often associated with the sulphides of iron and silver.

The modes of occurrence and association of gold are as follows :—

1. In quartz veins of the older rocks, those in the Lower Silurian contain the greatest quantity of gold. Examples are furnished by the auriferous lodes of North Wales.

2. In quartz veins in such Secondary rocks as have been penetrated by certain igneous eruptions, either in the intrusive rock, or in the Secondary strata, and then for a limited distance only beyond the junction of the two rocks. Such an association prevails in California, Central America, and Peru.

3. As auriferous detritus in Secondary and Tertiary deposits, and in the débris and alluvia of rivers, such having been derived from gold-bearing rocks. The *placer* mining of California, Australia, New Zealand, &c., is prosecuted in superficial drift deposits. Gold has been found in streams in Cornwall, Devonshire, Wicklow, and Scotland; and the sands and alluvia of rivers in many parts of the world are washed for this metal.

Our great supplies are drawn from the above sources. The chief are Australia and New Zealand, California and British Columbia, Brazil, Peru, Mexico, and Central America; the Ural, Altaï, and Carpathian Mountains. Gold is also obtained from Thibet, China, Japan, Further India, and Borneo; from the sands of African rivers, especially in Guinea, and from those of the Rhine, Rhone, Danube, and Tagus. Small quantities are procured in mining districts from iron and arsenical pyrites, and other sources, as in Silesia, Saxony, and parts of our own country.

The gold-producing countries of the world rank in order of importance according to the appended list:—

| | |
|---|---|
| Australia and California. | Africa, } equal. |
| Russia. | Austria, } equal. |
| New Zealand. | Nova Scotia. |
| Mexico and Central America, } equal. | Great Britain. |
| South America, } equal. | |
| East Indies, } equal. | |

Australia and California about equal in their yield, and stand with the rest of the states in relation to gold as Great Britain stands in relation to iron.

Russia produces about a quarter as much as either of the two great gold-bearing territories, and New Zealand less than a quarter. The other states, while productive of much gold in the gross total, cannot enter into comparison with California or Australia, which respectively enrich the

world yearly with about 4000 times the amount furnished by Great Britain, the last on the list.

There is much gold, not computed, in Borneo, and when the Dark Continent is opened up to commerce and civilisation, it may not impossibly prove to be the veritable El Dorado of the future.

## PLATINUM.

Platinum ranks with gold in its resistance to the influence of air, moisture, and the ordinary acids, and is the heaviest substance known (sp. gr. 21.5). It is white, exceedingly malleable and ductile, and extremely difficult of fusion. On account of its indestructibility it is of great use in the laboratory for crucibles, especially in making sulphuric acid. It is valuable in the arts, and has been employed for coinage by Russia. Since this intractable metal has been made to yield to the oxy-hydrogen flame, large masses weighing several hundredweights have been produced, and the applications have greatly increased.

Platinum rarely occurs pure. It is principally found alloyed with palladium, rhodium, iridium, iron, gold, or other metals, and generally in alluvial deposits. In the Ural Mountains it has been observed disseminated throughout the whole mass of certain crystalline rocks. The pure metal is got by adding sal-ammoniac to a solution of the alloy in nitro-hydrochloric acid, and washing and heating the compound thus produced. The sources of supply are the Ural Mountains, Brazil, Peru, Spain, Borneo, and Ceylon.

## SILVER.

Silver, like gold, is a noble metal, and is used very extensively for similar purposes. It also needs an alloy to harden it; and being less precious, as well as less weighty

(sp. gr. 10.5), is more available for common uses, especially many domestic ones. Its chemical preparations are valuable in photography and surgery. In colour silver is a beautifully brilliant white; it is sonorous, highly malleable and ductile, and perhaps the best conductor of heat and electricity.

This metal occurs pure in some rocks in very fine threads, and large masses of pure silver are occasionally met with in veins. But its supply is principally derived from ores, of which the chief are the *chloride* ($AgCl$), or *horn-silver*, a greyish crystalline mass, which looks like horn; the *sulphide* or *silver-glance*, and its combinations with the sulphides of antimony and arsenic, which are known as the dark and light red silver ores; and *argentiferous galena* (sulphide of lead), which often contains very considerable quantities.

Silver is obtained from its ores chiefly by roasting, crushing, and amalgamation with mercury. The separation from lead was formerly effected by the superior affinity of lead with oxygen in the process called cupellation, which was in every way costly; and unless the percentage of silver in the lead was large it was not separated. A process, known as Pattinson's, is now employed for desilverising lead; it is based upon the discovery that lead crystallises or consolidates at a higher temperature than an alloy of lead and silver; consequently, if argentiferous lead be kept at the lowest temperature at which the fluid state could be maintained, solid masses of pure lead are gradually formed and removed, the fluid portion remaining being exceedingly rich in silver; finally, the lead is subjected to the process of cupellation, and the silver separated.

The most abundant supply of silver is yielded by the mines of Mexico, Chili, and Peru, especially Pasco and Potosi. These mines occur in elevated districts, some upwards of

16,000 feet above the sea-level. Considerable supplies are also obtained from other parts of South America, in the Ural and Altaï Mountains, from China, Japan, Cochin-China, Thibet, Asiatic Turkey, Norway and Sweden, the Harz Mountains, Saxony, Hungary, Austria, and the lead districts of the British Isles. The silver-yielding regions are appended in the order of their productiveness. Great Britain does not produce either silver or gold in quantities sufficient to be worth working on their own account. Silver is found with the Cornish stream tin and in the Scottish Lead Hills. The largest percentage of silver is yielded by the rich sulphuret of lead (galena), by cupellation, a method of desilverisation which has grown into a profitable branch of industry :—

| | |
|---|---|
| Mexico. | Britain. |
| South America. | France. |
| Zollverein. | East Indies. |
| Spain. | Norway and Sweden. |
| Austria. | |

## MERCURY.

This extraordinary metal—quicksilver, as it is often called—fluid at ordinary temperatures, is the heaviest liquid with which we are acquainted (sp. gr. 13.59). It becomes solid at $-40°$ Fahrenheit, when it is both malleable and ductile. It is used for the extraction of gold and silver; as an amalgam in chemistry, and in the construction of scientific instruments; in manufactures, for silvering mirrors, and for vermilion; and in medicine, for the valuable products calomel and corrosive sublimate, the subchloride and chloride of the metal are respectively used.

Quicksilver is met with pure in minute globules, but for the purposes of commerce it is obtained from one of its ores—*cinnabar*, a red sulphide of mercury. This ore occurs

in the older rocks, but chiefly in those of the Carboniferous System, and the metal is procured from it by a process of distillation. The principal sources of supply are Almaden in Spain, and Idria in Austria, both very rich; Peru, California, Mexico, Australia, China, Japan, Ceylon, Bavaria, Bohemia, Tuscany, and Hungary. The countries productive of *cinnabar* are here placed in the order of their importance:—

| | |
|---|---|
| Spain. | Peru. |
| California. | Tuscany. |
| Austria. | Germany. |

## TIN.

This very useful metal is rather rare. It is but slightly acted upon by either air or water, is of a white silvery colour, malleable, and easily fused. Its specific gravity is 7·3. Besides being largely used in coating or tinning more oxidable metals, as iron, for instance, in the well-known material called tin-plate, and combining as an alloy to form pewter, bell-metal, type-metal, and solder, it is employed in its chemical combinations for a great variety of purposes in the useful arts. It is found as an oxide, chiefly in the metalliferous veins of the older rocks, also in association with wolfram (a double tungstate of iron and manganese), and, like gold, in alluvial districts, as stream tin.

By the processes of roasting, smelting, and refining, the stream ores produce the grain tin, which is the most esteemed, and the others the bar or block tin. The most productive districts are Cornwall and Devonshire, the Malayan Peninsula and islands, especially Banca and Billiton, to the south of it, and Tenasserim, in the East Indies, China, Saxony, Bohemia, Hungary, Peru, New Granada, Bolivia, Mexico, France, Spain, Siberia, and Australia. The annual supply of tin is derived from the

following states, in their respective order of produce, Great Britain standing pre-eminent, as in Iron.

| | |
|---|---|
| Great Britain. | Japan. |
| East Indies. | Siam. |
| Australia (Victoria). | Austria. |
| China. | |

## COPPER.

Copper is a metal of great commerical value, and of very extensive use. It is of a fine red colour, very malleable, ductile, and tenacious, highly sonorous, and a good conductor of heat and electricity. Its specific gravity is 8.96. Independently of its use for coin, sheathing for ships, boilers, and domestic utensils, and of its alloys with gold and silver to harden those metals, copper enters into the composition of brass, bronze, pinchbeck, ormolu, gun-metal, bell-metal, German silver, and the biddery ware of India. It is also largely employed in the production of colours (blue and green), in telegraphy, and in medicine.

It occurs native in fine threads, and occasionally in large masses, the most remarkable of which have been found in Brazil, the district of Lake Superior, and Australia. The principal ores, which occur either in veins or beds, and are most abundant in the primary rocks, are copper pyrites, a sulphide of the metal combined with sulphide of iron; the red oxide ($Cu_2O$), the black oxide, the green and blue carbonates of copper, and the purple and grey copper ores, the latter associated with iron, antimony, and arsenic. The reduction of the ores is a matter of some difficulty. In Britain it is chiefly carried on in the neighbourhood of Swansea.

Ores of copper are found in Cornwall, Devonshire, Flintshire, Wicklow, and many other parts of the British Isles; Chili, South Australia, the Ural Mountains, United States and Canada, near Lakes Superior and Huron;

associated with trap rock in Brazil and Cuba; in the copper schists of Mansfield, in the Harz, Saxony, and other parts of Germany; in Sweden, Tyrol, Hungary, Tuscany, Spain, Persia, India, China, Japan, Algiers, South Africa, and New Zealand. Malachite, a beautiful ore of copper (carbonate), found abundantly in Russia and Australia, can be used as an ornamental stone. The sources of the world's supply of copper may be thus tabulated:—

| | |
|---|---|
| Chili. | France, } equal. |
| Great Britain. | United States (Lake Superior), } equal. |
| South Australia. | Germany. |
| Cape of Good Hope. | Austria. |

## LEAD.

This metal, the heaviest of the baser metals (sp. gr. 11.45), is soft, easily fused, and very slightly sonorous. It is largely used in roofing, lining, plumbing, and bullet and shot making. It also enters into the composition of pewter, solder, and type-metal; and in its chemical combinations it forms litharge (the oxide), a yellow paint; red lead (red oxide), a cheap substitute for vermilion; white lead (carbonate), manufactured on an immense scale for the painter; and sugar of lead (the acetate), of great value to the chemist. These substances are highly poisonous.

The most abundant and important of the ores of lead is *galena*, a sulphide of the metal, yielding eighty-six per cent. of lead, and almost always containing silver, which is separated when the quantity is not less than four ounces to the ton. The other ores are: the *carbonate of lead*, the *vanadiate of lead*, the *cupreous sulphate of lead*, and the *arsenio-phosphate of lead.* Galena is found very abundantly in the limestones of the Carboniferous series, and to a less extent in older rocks. Its reduction is effected by pounding, washing, and smelting in a reverberatory furnace. Lead-mining is

carried on in Britain (Northumberland, Cumberland, Durham, Derbyshire, Flintshire, Cornwall, Isle of Man, and Leadhills); also in Spain and Portugal, France, Belgium, the Harz Mountains, Saxony, Rhine Provinces, Bohemia, Carinthia, Hungary, Norway, and Sweden; Altaï Mountains, China, and Indo-Chinese Peninsula, South Africa, Peru, California, United States, and Canada.

Spain stands in the first rank for the supply of lead, followed at a long distance by Great Britain, and, still farther behind, by Germany. France comes next, and Sweden contributes a few hundred tons.

## ZINC.

This metal, of a bluish-white colour, and specific gravity about 7, has the remarkable peculiarity of being malleable and ductile only between the temperatures of about 250° and 300° F., and of retaining its malleability when cooled. It forms a cheap substitute for many of the applications of lead, such as tanks, pipes, roofs, and for bronze in ornamental works. It enters into the composition of brass, and is used in domestic manufactures, printing, engraving, sheathing of ships, coating of galvanised iron, electrical apparatus, and medicine. Its oxides form valuable white and grey paints.

The principal ores of zinc are, *calamine*, a carbonate ($ZnO,CO_2$); *blende* or *blackjack*, a sulphide; and a silicate or *electric calamine*. They occur often in association with the ores of lead, and frequently with the ores of copper and tin, chiefly in limestones of the Carboniferous and Devonian Systems. The pure metal is obtained by roasting and distillation, as it is very volatile at a red heat. The ores are largely worked in Belgium, Silesia, Rhine Provinces, and Hungary. Zinc is also produced in Flintshire, Derbyshire,

Cumberland, Cornwall, Devon, Ireland, Wales, Isle of Man, Sweden, Bohemia, Carinthia, Spain, the Harz, Canada, New Hampshire, and New Jersey, in which last place the metal occurs in the mineral red zinc ore, an oxide of zinc. Germany comes forward as one ground of reliance for zinc; about half as much is obtained from Silesia. Belgium and Sweden add to the yield; and about a third as much as the produce of these two countries together, is furnished by the United States and Great Britain. Austria and Spain bring up the rear with a modest contribution.

## ALUMINUM.

This metal is white, resembling silver, and is of low specific gravity (2.6). It exists abundantly in nature as the metallic base of argillaceous and felspathic rocks, which are silicates of alumina, and as sulphate of alumina, an important constituent of the alums. The pure metal has lately been obtained in quantities available for manufacturing purposes; and from its extreme lightness, its freedom from tarnishing, and its sonorousness, promises to become a most useful product. The metal can be separated from the earth alumina, or from the chloride; but it is obtained economically only from *Cryolite*, a double fluoride of aluminum and sodium, found in Greenland.

## ANTIMONY.

Antimony is white and brittle, with a specific gravity of 6.8. As a simple metal it is not used, but it forms valuable alloys. With lead and bismuth it is largely used in the preparation of type-metal, which consists of six parts of lead and two of antimony; with lead and tin for plates on which music is engraved, and with the same for stereotype metal. A small proportion of antimony combined with tin forms hard pewter, and with tin, bismuth, and copper, the

white or Britannia metal. It is also very extensively employed in medicine. It occasionally occurs in nature pure, but usually combined with sulphur, or sulphur and lead; it is also found in combination with arsenic, and with nickel, silver, and copper.

*Grey Antimony*, a tersulphide, affords nearly all the antimony of commerce; it is found in Hungary, Saxony, and the Harz, Belgium, France, Italy, Spain, Siberia, Mexico, Malacca, the Indian Archipelago; was at one period produced in considerable quantities in Cornwall and Dumfriesshire; but now the principal part of our supply of antimony is from Borneo and the East Indies.

Central Italy affords the largest European supply of antimony.

## BISMUTH.

Bismuth is a brittle reddish-white metal (sp. gr. 9.9) which fuses at a very low temperature. It fuses still lower in combination with lead and tin, with which it is used as a solder, and with which it also forms the metal called "Newton's" fusible at the boiling point of water. It enters, too, into the composition of Britannia metal, pewter, and type-metal, and is of some use in medicine. Bismuth is found, tolerably pure, usually associated with ores of tin, copper, and silver, in Cornwall, France, Bohemia, Saxony, and Sweden, and occurs also in the primitive rocks of some of the Cornish mines, combined with the ores of cobalt and nickel.

## COBALT.

Cobalt is a white, brittle, and very tenacious metal. Its specific gravity is 8.5, and it is strongly magnetic. It is very useful in its chemical preparations as producing fine colouring substances, chiefly blue, such as smalts, cobalt-ultramarine, and zaffre or saflor (a corruption from sapphire).

The principal ores are cobalt-glance, a combination with arsenic, the black oxide, and cobalt bloom; they are found in Norway and Sweden, Saxony, Hungary, Rhenish Prussia, and United States.

## NICKEL.

This metal is also found combined with arsenic. It is white or steel grey, malleable, and but slightly affected by air and moisture. Its specific gravity is 8.5, and it is magnetic until subjected to great heat. With copper it forms German silver, and its alloys form excellent bases for electroplating. A fine green colour is obtained from its preparations. Nickel has been used in the United States for coin. Its chief ore, "kupfernickel" or speiss, often associated with cobalt, is found in Westphalia, Saxony, Hesse, Hungary, and Sweden. Nickel occurs in meteoric iron. British nickel is met with in Cornwall, Cumberland, and the Lead Hills.

## ARSENIC.

Metallic arsenic is grey, highly lustrous, crystalline, and brittle (sp. gr. 5·7). The arsenic of medicine is the white oxide, or arsenious acid, a virulent poison; this is also largely employed in preparing some of the finer skins and furs of Russia. This metal enters into the composition of some valuable pigments, especially a brilliant green and an orange red. It is also combined with lead in the manufacture of shot. Arsenic is rather widely diffused; and although sometimes pure, it is usually found combined with other metals, with sulphur, and with oxygen. The chief amount is obtained from the arsenides of iron, nickel, and cobalt, and the supply is chiefly derived from Bohemia, Hungary, Saxony, Salzburg, Transylvania, Rhine Provinces, and France. *Realgar*, a red sulphide ($AsS_2$) is found in

Bohemia and Saxony; and *orpiment*, another sulphide ($AsS_3$), a fine yellow, in China and South America.

Arsenic is also procured from the tin-mines of Cornwall, the ores being roasted and sublimed; the produce, when collected, constitutes the arsenic of commerce and industry.

## MANGANESE.

Manganese oxidises at ordinary temperatures, and is never used in the arts in the pure state. It is of a reddish hue, brittle, so hard as to scratch glass, and has a specific gravity of 7.13. The binoxide ($MnO_2$) is an important article of commerce largely employed in glass manufacture and for colouring pottery, and by the chemist in the preparation of oxygen. Sulphate and chloride of manganese are used in calico printing; the former gives a valuable brown dye. It is found that a slight addition of this metal much improves the cast steel made from British iron. The principal ores of manganese are *Pyrolusite* and *Psilomelane*, both binoxides, the former anhydrous, the latter containing 1 per cent. of water. *Wad*, an impure manganese ore, may be employed, like the preceding, in bleaching, and also for umber paint. Manganese ores are procured from the Harz Mountains, Piedmont, France, Spain, Nova Scotia, Somerset, Devon, Isle of Man, and were formerly obtained from Cornwall and Italy.

## CHROMIUM.

This metal, in its pure state brittle, difficult of fusion, and like iron in colour, is important in the arts for the beautiful colours produced by its combinations. The most important of these are the sesquioxide of chromium, a fine green, bichromate of potash, and bichromate of lead, yellow and orange. The principal ores are chromic iron (chromate

of iron) and chromate of lead, the former occurring usually in serpentine rocks in the Shetland Isles, France, Norway, and the United States, and the latter in Siberia, the Urals, and Brazil.

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## II. *MINERALS PROPER.*

### COAL.

Coal is very generally diffused, and occurs of different geological ages in various parts of the world; but by far the greater proportion of valuable workable coal is derived from the Carboniferous series of formations. Good workable coals are obtained in the Lias and Oolite; brown coals and lignites are of Tertiary age. Coal consists of vast collections of carbonised vegetable matter impregnated in varying degrees with the pitchy and resinous substances now so characteristic of the fir family. Peat bogs in superficial beds present perhaps the first stage in such a change. These masses of vegetable matter, though containing much water, can be made available for house fuel, fuel for manufacture, very fair charcoal, and for the extraction of naphtha, paraffin, and tar. In the presence of an abundant supply of coal, peat cannot be economically employed, but it is extremely useful where coal is scarce, as in Holland, many parts of France, Germany, and Ireland. A nearer approach to true coal is the lignite, woody, or brown coal. This mineralised vegetable product, like peat, contains a considerable quantity of moisture, and it suffers in quality on exposure to the air. It is a Tertiary deposit, and is found in Breslau, on the Rhine, in Germany, on the Danube, and the shores of the Baltic, in Styria, Tuscany, Nova Scotia, New Zealand, Devonshire, and County Antrim. True coal is very compact, has for the most part lost its woody and fibrous character, and contains

a very small quantity of earthy matter. It consists of two principal varieties, the bituminous and the anthracitic. Bituminous coals contain a large proportion of gas, tar, paraffin, and such substances, and burn, therefore, with a brilliant flame. They are, hence, peculiarly adapted for domestic consumption, for gas, manufactures, and coke. The bituminous coal richest in volatile constituents is the variety called "Cannel"—in Scotland the "Parrot"—which burns with great brilliancy. Other varieties are splint and cubic coals. A semi-bituminous coal, burning with less brilliancy and rapidity, but affording great heat, is called "steam coal," from its use in furnishing the supplies of steam vessels taking long voyages. The middle part of the South Wales coal-field (the western is bituminous), and a part of the Newcastle field recently worked, contain excellent coal of this character.

Anthracite coal is very hard and glossy, not soiling the fingers. It is almost pure carbon, containing but a very small proportion of gaseous products. It burns with a very feeble flame, but gives an intense heat. From its comparative difficulty of combustion it was formerly but little used, but by the introduction of the hot air blast and other improvements in furnaces, it can be made available for many manufacturing processes, particularly that of the preparation of iron, for which it is now extensively used in Wales (the eastern part of the coal-field being anthracite) and the United States.

Notwithstanding the enormous consumption of this important fuel, the supply will, perhaps, *never* be exhausted. Immense areas in the New World must be added to the still profusely abundant districts of the Old. The coal area of Great Britain and Ireland is about 9000 square miles, that of the rest of Europe about the same, or rather less; and to known deposits in Asia, South America,

Australia, and Africa, must be added no fewer than 150,000 square miles in the United States and Canada.

Many bituminous substances are produced in vegetable matter during its conversion into coal; the chief of these are naphtha, petroleum, and asphalt, which are all hydrocarbons of varying proportions, and of an inflammable nature. The bituminous substances are widely distributed, especially in the tropical and sub-tropical regions—a circumstance which evidently indicates that the substances are due to extensively operating natural causes, and not, as usually supposed, to the accidental combination of special agencies.

The modes of occurrence of asphaltic deposits seem referable to three principal divisions. 1. In the rocks of igneous origin; this is the case in Cuba, and at Mount Lebanon. 2. In stratified rocks of the Palæozoic and Mesozoic epochs, usually disseminated in a granular form throughout the entire stratum, or issuing from the soil, or exuding from fissures in the rocks, in the form of springs of petroleum, naphtha, &c. 3. In rocks of Tertiary age usually accompanied by lignite or brown coal. These are the most abundant sources of asphaltic substances, and include also those of Pegu and Trinidad.

*Naphtha* is a transparent and nearly colourless fluid, burning with a copious flame and strong odour, and leaving no residuum.

*Petroleum* is dark-coloured, and thicker than common tar. It rises in immense quantities from some of our coal beds, and impregnates the earth so as to form springs and wells. Petroleum springs contain a mixture of petroleum and the various substances allied to it: they occur in abundance in Italy, Persia, on the shores of the Black Sea, in Canada, United States, &c., but the most powerful are those in the province of Pegu, in the Burman Empire. In many parts

of the world petroleum is now the most abundant source of photogen and paraffin. The petroleum or rock oil of the United States is refined for illuminating purposes, while in the crude state it is a good lubricant.

*Bitumen*, or *Asphalt*, is an inspissated mineral oil, of a dark brown or black colour, with a strong odour of tar; the most valuable is hard, brittle, of a brilliant lustre, and eminently conchoidal fracture; a variety occurs of the consistency of jelly, and bearing some resemblance to soft indiarubber. It is very abundant on the shores of the Dead Sea, occupies the so-called pitch-lake in Trinidad, and occurs in Cuba, Peru, Mexico, Ionian Isles, Portugal, &c.

The Rangoon tar, or Burmese naphtha, is distilled from a number of volatile hydro-carbons, chiefly used as lamp fuels; those known as Sherwoodole and Belmontine have considerable detergent power, removing stains from silk without impairing delicate colours.

Beds of limestone and clay occur impregnated with bitumen, and from such, paraffin is distilled in Britain, Germany, France, Austria, &c.

The principal *working* coal-fields, according to their present output, rank in the appended order; premising that Great Britain "wins" close upon twice as much coal every year as the rest of the fields put together, and that only Germany, including its lignite or brown coal, the United States, and France, can be fairly mentioned in the category with our own country. Belgium and Austria succeed, while Nova Scotia, Australia, Spain, India, Sweden, New Zealand, and smaller fields combined do not reach the output of Austria at present, but are capable of great development. Some of the New Zealand beds are remarkable as forming part of the mountain masses, and are dug by tunnels in the mountain-sides, not by sinking pits; the weight of

the full trucks in descent being used to haul up the trains of empties.

## OTHER BITUMINOUS SUBSTANCES.

*Jet*, so much prized in the manufacture of ornaments for its intense blackness, its lightness, and its beautiful polish, is a variety of lignite highly bituminised and free from earthy impurities, and resembles Cannel coal, but it is blacker, and has a more brilliant lustre. It occurs in the aluminous shale of the Upper Lias of Whitby, in which it is very abundant, in Languedoc, Asturias, the Alps, Galicia, and Massachusetts. The value of the jet manufacture at Whitby is very considerable.

*Amber* is a fossil resin, the origin of which has been traced to coniferous trees, and is found in alluvial gravels. It occurs, too, in the Cretaceous marls of France and Germany. It is procured from Prussia, the shores of the Baltic, the Adriatic and Sicilian shores, and from Japan, Madagascar, and the Philippine Islands.

*Gum Copal* is a semi-fossilised resin found in a sandy soil in the hilly districts all along the coasts of Angola, the total yearly export of which from all the districts of Angola is estimated at 2,000,000 lbs. A gum copal is obtained under similar conditions from Sierra Leone and Zanzibar; the origin of which, as well as that of Angola, is still unknown.

Some copal resins are exudations from living trees, as that furnished by *Guibortia copallifera* of Sierra Leone, and others.

## CALCAREOUS* SUBSTANCES.

The metal *calcium* very readily oxidises and forms lime, which easily enters into combination with carbonic acid,

* That is, having the nature of limestone.

forming carbonate of lime—the base of limestone, chalk, marble, and calc-spar—and with sulphuric acid and water to form gypsum. Carbonate of lime in its various forms is a most abundant substance, and of the most extensive use, whether in its native condition as stone for building, paving, statuary, and smelting, or in its preparations—mortars and cements, in glass-making, leather-dressing, bleaching, agriculture, and medicine.

Common limestone is found in almost every geological formation; compact, and often crystalline in the older rocks, but generally loose and more earthy in the newer. It is abundant in nearly all countries, in varying qualities and degrees of adaptation to its numerous uses. In England it chiefly occurs in the rocks of the Devonian and Carboniferous series—Mountain Limestone especially—and in the Liassic and Oolitic systems. The dolomite or magnesian limestone belongs to the Permian group of rocks. The best kinds of limestone for building are those of Portland, Bath, Box, and Corsham, all of which are Oolitic, and the magnesian limestone of Notts and Yorkshire. The Oolite of Bavaria furnishes a very fine lithographic stone; these stones are also supplied from older rocks in Canada, and from France, Greece, and Portugal.

Of ornamental limestones, those of South Devon are extensively worked. Some interesting varieties of the red, grey, and variegated marbles (so-called) are obtained near Torquay. Many blocks are almost entirely formed of fossil corals, and known as *madrepore* marbles. The Carboniferous rocks of Derbyshire are rich in ornamental limestones, the chief varieties of which are the *entrochal* or *encrinital* marble, *productal* marble, and *black* marble. The former of the first two is built up of the stony fragments of stone-lilies (*Encrinites*), whilst the latter is composed almost entirely of shells of the genus *Producta*. Other marbles of a like character

are obtained in Staffordshire, Somersetshire, and Ireland. The Purbeck and Petworth marbles are limestones charged with the fossil shell *Paludina*, and hence are sometimes called paludinal marbles; they belong to the Purbeck and Wealden series respectively, and were formerly employed extensively in ecclesiastical architecture.

The true marbles are altered limestones or dolomites. The finest is the pure white or statuary marble; others are red or yellow in colour, and either pure or streaked. They are firm in texture, finely grained, and susceptible of a beautiful polish; hence their use for ornamental purposes. Italy is pre-eminently a marble-producing country, to which fact must be ascribed the splendour of her palaces and other public and private structures, in which not only the architectural ornaments, but frequently, as in the case of the cathedral at Milan, the entire edifice is built of the finest marble. Italy has of late years produced an average of 250,000 tons per annum of statuary marble. The best white marble is now obtained from Carrara, quarried in the Apennines where they approach the Mediterranean. India, Sicily, Spain, Ireland, the United States, and other countries also furnish it.

Coral limestone belongs to this group of mineral products. It is a recent formation; and the rock is sometimes used as a building stone in the South Sea Islands. Great numbers of these islands, as well as numerous others in the Indian Ocean, are themselves natural coral structures. Coral reefs are abundant in tropical seas, in the North Atlantic, and the Pacific and Indian Oceans.

*Marl*, a mixture of clay with carbonate of lime, occurs as clay-marl, marl-clay, and shelly-marl. It is procured from valleys which have formed the beds of lakes, and from the neighbourhood of existing lakes, and is useful as a manure. Calcareous sand, formed chiefly of crushed shells,

and found on ancient and modern beaches, is also used in agriculture. Of such sand, 8,000,000 cubic feet are annually removed from the Cornish coast into the interior of the country. Some of the shelly deposits of the Crag formations, in the east of England, are similarly used.

*Gypsum* is a very valuable mineral, occurring chiefly in the New Red Sandstone and in Tertiary deposits, but also among earlier rocks. It is abundant in England, Ireland, France, Canada, Nova Scotia, and in many other places. Gypsum forms the plaster of Paris, of such utility in building and modelling; crystallised, it is met with as *selenite*, *satin gypsum*, and *alabaster*. The use of this last, for statuary and ornamental work, dates from the remotest times of Etruscan art. Statuary alabaster is obtained from the Miocene and Pliocene strata in Tuscany and in Egypt.

Limes, stuccoes, and cements, so indispensable in all building operations, are obtained from various carbonates. Pure carbonates make rich limes, which are such as set only in dry air; impure ones (with mixtures of clay) yield hydraulic limes, which possess the valuable property of setting in moist air, and even under water. The septaria or calcareous nodules in London clay, at Sheppey, those procured at Harwich, the cement stones of the Lias at Whitby, of the Speeton Clay of Yorkshire, and the Lower Lias limestone, furnish suitable limestone for hydraulic cements.

## SILICIOUS SUBSTANCES.

Another very important mineral substance is silica, which is a combination of oxygen with the metalloid silicium or silicon. The purest examples of silica are rock-crystal, quartz, and flint. The colourless crystals, especially the so-called Brazilian pebble, are much used for lenses.

Quartz, which, crystallised, constitutes several of the gems, is an important constituent of granitic rocks; and, in the form of sand, it is the principal ingredient in all sandstones. Quartz, well powdered, is combined with fine clays in the manufacture of porcelain in China, as flint is also in this country. Flints are irregular masses of nearly pure silica, occurring as nodules distributed in layers, in the Chalk formation especially. Reduced to powder, they enter into the composition of china, porcelain, and glass; and, whole, they furnish a rough building material.

Sandstones are of very various composition and of different degrees of hardness. They consist of silicious sands, often mixed with other substances, all cemented together by means of carbonate of lime, oxide of iron, silica, or clay. They are of all geological ages, the oldest being usually the most compact. When hard and cross-grained they are denominated grits. If pebbles very largely predominate, they are called conglomerates, and these are either pudding stones with rounded pebbles, or breccia with angular fragments. The extremely hard and schistose grits are very useful for flag-paving. The best qualities of these are supplied from Forfarshire and Caithness. Millstones are obtained from the Millstone Grit of Newcastle, from Yorkshire, Belgium, France (especially at La Ferté), and Wurtemburg. They are also made from a silicious limestone near Paris, and out of lava at Andernach. For building purposes, the finest sandstone is quarried at Craigleith and other localities in the Carboniferous formations of Scotland. Good stone is obtained from rocks of the same age in Durham, Yorkshire, Derbyshire, and from Queen's County and other parts of Ireland.

Silicious sands are much in request in the arts, as in building for mortars, in moulding and casting, and in glass-making. The most valuable for the last-named purpose are

procured from Senlis in France, from the Isle of Wight, Lyme Regis, Aylesbury, and Reigate. *Rottenstone*, found in Derbyshire and elsewhere, is a decomposed silicious limestone, and is used for polishing. Bath brick, Tripoli powder, the polishing powder from Bilin in Bohemia, the *Berg-mehl* of Sweden and America, and the French *tellurine*, are peculiar mealy forms of silica.

## IGNEOUS AND METAMORPHIC ROCKS.

Granites, and their allied rocks, gneiss, mica-schist, and felstones, consist largely of silica. Their chief mineral constituents are quartz, felspar, and mica (white, green, or black). Felspar is a silicate of alumina and potash, or, in the case of *albite*, the white felspar of Cornish granite, of alumina and soda. Mica is a silicate of lime and alumina or iron. Where hornblende, a dark green silicate of lime and magnesia, has taken the place of mica, the stone is called *syenite.* These rocks assume a structure termed porphyritic, that is, they are composed of crystals embedded in an amorphous matrix, and are highly valued for ornamental purposes. These latter, and white granite, are obtained from Cornwall and Devon, red and grey granites from Aberdeen and Peterhead, and a very hard and dark variety from Guernsey, the Malvern Hills, and Leicestershire. Granitic rocks are abundant in many parts of the world, Ireland, Norway and Sweden, India, and China among others; and Egypt is famed for its syenite and red porphyritic felstone. They furnish a durable and highly polishable building material particularly well suited for bridges, quays, and monumental works. The coloured varieties are eminently adapted for ornamental purposes. *Mica* is often found in large crystals, which can be split up into plates and used as glass. This is the material known as Siberian glass, from the country

whence it is supplied. *Talc* is a similar mineral, and is employed in the porcelain and crayon manufactures: it forms, besides, the French chalk. *Asbestos* is a fibrous variety of hornblende. It can be woven into a fire-proof cloth, and is also made available in open gas stoves.

Serpentine, so called from the supposed resemblance of the mineral to the skin of a serpent, is a silicate of magnesia with adventitious admixtures of lime, alumina, iron, chromium, &c., and occurs as a rock or in association with other minerals constituting rock masses. The west of Mayo and Galway are remarkable for their serpentine rocks, which afford the beautiful variegated green and white varieties worked into pilasters, columns, &c. Serpentines and serpentine limestones are also quarried in Cornwall, the Shetlands, Canada, United States, Italy, &c.

Basaltic and kindred rocks—greenstone, whinstone, and trap—are intrusive rocks, for the most part felspathic. Some of these are well adapted for building, but their great use is for paving and macadamising roads, for which purposes they are unrivalled. The columnar structure of basalt is in some places taken advantage of for the construction of stone posts and window-sills. These rocks are abundant in Scotland, and occur also in Ireland, Germany, and Nova Scotia.

*Lava*, a volcanic production, is often similar to trap, and equally useful. It occurs in recent and extinct volcanic districts. *Obsidian*, a volcanic glass, usually black, and somewhat resembling the slag of a glass furnace, is found in Mexico, Central America, Peru, and Iceland. *Pumice stone*, a well-known, porous, and extremely light stone, used for polishing, and *Pozzuolano* and *trass*, silicious earths much used to mix with limes for hydraulic cements, are also volcanic productions, of which the chief mineral ingredients are augite and felspar. Pumice is quarried in the islands

off the coast of Sicily. Pozzuolano and trass are obtained from Italy, France, Germany, and Scotland.

## CLAYS AND ALLIED SUBSTANCES.

Clays, which are silicates of alumina more or less pure, occur in all formations, from the firmest slates of the older rocks, and the loose shales of the Carboniferous and the Secondary, to the plastic clays of the Tertiary and the alluvial deposits. They enter largely into the materials and processes of building, as slates, tiles (both for roofing, paving, and ornamental purposes), and bricks; into the manufacture of pottery of all sorts, terra-cotta, and many other useful applications. The common clay, so abundantly diffused over the earth's surface, and chiefly distinguished into three varieties—yellow, brown, and blue—furnishes material for the builder and the maker of the common pottery wares. China and porcelain are made from the fine clays called *kaolin* and *petuntse*, which are almost pure, and are due to the decomposition of the felspars of granitic rocks, the felspar containing soda being especially liable to disintegration. These clays are found in Cornwall, Devon, France, Belgium, and Germany, but can also be artificially prepared. *Pipe clay* is a white, pure variety, with an excess of silica. It is obtained from Poole and Purbeck. *Fire* or refractory clays used in the manufacture of fire bricks, retorts, and crucibles, contain a preponderance of silica over alumina, and occur chiefly in the Carboniferous strata. In England the Stourbridge clay is famous for these purposes. Belgium, and Siegburg in Germany, also furnish fine clays. Others, however, sufficiently pure, can be made available to some extent by the addition of silicious sand. *Fuller's earth* is a very useful clayey substance, having in its composition a large proportion of silica and a quantity of water. It is

employed in the preparation of wool, and is abundantly met with in Surrey, Buckingham, Hampshire, Gloucestershire, and Bedford. The *ochres*, chiefly red and yellow, are mixtures of clay and oxide of iron. They are used in the manufacture of colours, and are obtained in the neighbourhood of Oxford, in Fife, in Antrim, Italy, and other places.

*Slates*, from their natural cleavage and their great durability, are of extreme utility for a variety of purposes, chiefly roofing, the construction of cisterns, and the manufacture of school slates and pencils. The best are those which are hardest and finest in grain. Besides the common colour, there are green, purple, and grey slates. The laminæ are of different thicknesses, and are used accordingly. Slates are quarried chiefly from rocks of ancient date (Silurian and Cambrian), and are abundantly supplied from Penrhyn, Llanberis, Festiniog, and other parts of Wales, as well as from Cornwall, Devonshire, Westmoreland, Scotland, Ireland, France, Belgium, Germany, and Asia.

Hone stones, of which there are many varieties, are slaty stones which are used in straight pieces for sharpening tools after they have been ground on grindstones. The most important varieties are the following:—Norway ragstone, the coarsest variety, imported in large quantities from Norway; Charnwood forest stone, one of the best substitutes for the Turkey oil stone, much in request by joiners and others, and obtained from Charnwood Forest, Leicestershire; Turkey oil stone, of which there are two varieties, white and black, the latter being the harder, surpassing every other oil stone, used by the engraver, and obtained from the interior of Asia Minor; Ayr stone; snake stone; Scotch stone, used especially for polishing copperplate; Welsh oil stone, second only to the Charnwood Forest stone, and obtained at Llyn Idwall, near Snowdon, whence is also obtained the "cutler's

green stone;" and the German razor hone, derived from a yellow band in the blue slates of the neighbourhood of Ratisbon.

## EARTHS OF SODIUM, POTASSIUM, BORON, SULPHUR, &c.

The elements, the combinations of which we are about to speak, do not, for the most part, occur naturally in their simple state, but their compounds, especially those of sodium, potassium, and sulphur (which is also native) are numerous, abundant, and valuable.

*Common Salt*—chloride of sodium—is an extremely abundant and quite an indispensable commodity. It exists in sea-water and salt lakes, in the proportions of from 2 to 4 per cent., or even more in some of the lakes, and can be extracted by evaporation; while from many brine-springs connected with geological deposits of salt as much as 25 per cent. is derived, and these deposits form now by far the best sources of supply. Rock-salt is obtained in England principally from the mines of Cheshire, and also near Belfast. Culinary salt is manufactured in large quantities in Cheshire and Worcestershire from brine-springs, the aggregate production reaching nearly two million tons, of which Cheshire supplies three-fourths. In both cases, the salt is derived from the Keuper marls of the New Red Sandstone System, where it occurs in basin-shaped deposits, and is arranged in wedge-shaped masses. Salt beds occur in rocks of various ages; those of Nova Scotia in the Carboniferous System, the rock-salt of Ireland, England, and Prussian Saxony in the Keuper formation, that of the Carpathian Alps in the Upper Oolite, that of Poland and the Pyrenees in the Cretaceous series, and that of Pisa and Cuba in the Miocene rocks. Beds of salt occur also in China and many districts of North America. Some of the

salt-mines of Europe furnish perhaps the most stupendous examples of mining industry. Salt for domestic purposes is refined from the more or less impure native product, and from it also common soda, or carbonate of soda, formerly made, like barilla, from the ashes of sea-weeds, is manufactured on an immense scale. Chlorine for bleaching and disinfecting purposes is also very largely supplied from the same source. Many parts of the earth being deficient in salt, it is an important article of commerce. After coal and iron, salt ranks highest in our exports. India and the United States receive the largest quantity, but we likewise supply the Dominion of Canada, the West Indies, South America, Africa, Australia, France, Holland, Belgium, the Baltic and the Mediterranean.

The *Alums*, already alluded to under the head of aluminum, are important compounds of sulphate of alumina with sulphate of potash, or soda, or ammonia, potash being the most common. Alum occurs native to a small extent, but from its great value in the arts, especially in dyeing and calico printing, it is manufactured on a large scale. One process is to treat clay with sulphuric acid, by which a sulphate of alumina is formed, to which potash, soda, or ammonia is added, and the resulting crystallised salt is accordingly either a potash, soda, or ammonia alum. Alum is also made from *alum slate* or *shale*; this substance contains alumina, protoxide of iron, a trace of potash, and iron pyrites dispersed through it. This pyritous shale, on exposure to the atmosphere, undergoes decomposition, which is accelerated by the manufacturer, who, availing himself of the carbonaceous character of the shale, applies fire to the alum shale heap. The iron pyrites is changed into sulphate of iron, which forms, with the alumina, a double sulphate of iron and alumina; this is subsequently purified by evaporation, and by the addition of potash the salt is rendered

crystallisable. Glasgow, Whitby, and Newcastle are the chief localities of alum manufacture in this country. The best alums are those prepared in Asia Minor and Italy, exported from Smyrna in the former country, and supplied by the latter under the name of Roman alum. China produces a considerable quantity, and Tuscany many tons per annum.

*Natron*, a native sesquicarbonate of soda called *trona*, and mineral soda, is found in sandy soils in Egypt, Mexico, Hungary, &c. Large quantities are collected from the lakes of Sukena in Africa, and chiefly used for native consumption.

*Borax*, an important article, very useful in chemistry and the arts, is a compound of boracic acid and soda. It occurs in the waters of some lakes in Thibet and Persia, and is imported in an impure state, as *tincal*, from the East Indies. Much, however, is manufactured from boracic acid obtained in a native state by the evaporation of the mineral waters from the extraordinary volcanic lagoons of Tuscany, and from *hayescine*, a borate of lime found in Peru. The annual produce of boracic acid from Tuscany has of late years been about from 1800 to 2000 tons.

*Saltpetre*, *nitre*, or nitrate of potash, is a natural product occurring on the surface of the soil in some hot and dry countries. It can also be prepared artificially, as is done in France, Germany, and other places. The British supply comes chiefly from the East Indies, to the amount of 18,000 tons annually; the annual importation from other sources is about 5000 tons. Besides being the chief ingredient in gunpowder, it is largely used in chemistry, medicine, and the arts.

Nitrate of soda, or *cubic nitre*, is found native in immense quantities as a geological deposit in Northern Chili and Peru, and is probably abundant over the salt plains of the

same continent. It is largely imported by this country, and used in agriculture, and for many of the purposes to which saltpetre is applied.

*Sulphate of baryta*, or heavy spar, is a beautifully crystallised mineral, occurring in mineral veins, in Cumberland, Westmoreland, Derbyshire (as cawk), Carinthia, Algiers, and Nova Scotia, and is a spurious substitute for white lead. The minerals *Celestine* (sulphate of strontia) and *Strontianite* (a carbonate of strontia) are used in the arts for the manufacture of the nitrate of strontia, which is employed for producing a red colour in fireworks. The salts of strontia are remarkable for the red colour which they impart to flame, whilst those of baryta give a green colour. *Fluor spar*, fluoride of calcium, is also a beautiful mineral, and important as the principal natural source of hydrofluoric acid and other combinations of fluorine. It occurs in the lead veins of Yorkshire and Derbyshire, and, from its rich colours, is used in the ornamental manufacture of tazza.

*Sulphur* is an element existing abundantly in various metallic and non-metallic compounds; but it also occurs native in quantities sufficient to render its extraction from its combinations almost unnecessary; it is, however, separated for economic purposes from iron pyrites. It is found native in all volcanic regions, either as an efflorescence on the surface, or largely impregnated in earths. Sicily and Iceland possess it as a volcanic product, and from the former our chief supply is obtained. Spain also supplies this substance. Sulphur is a very important article as an ingredient of gunpowder. Sulphuric acid (vitriol), so indispensable in the arts, together with other valuable sulphur compounds, has already been referred to.

*Graphite*, *plumbago*, or *black lead*, although pure carbon, contains a variable quantity of iron up to a proportion of 5 per cent. It occurs in beds and embedded masses, in

fissures in granitic and slate rocks, in nodules in greenstone, and, rarely, in mineral veins. This mineral, well known as the material from which the black-lead pencils of the finest quality are produced, is comparatively rare. It has been found on the right bank of the great river Tungouska, in a country previously little known. In the depths of pine-forests, and at the level of the waters of the wild Tunbusi, torn and abraded by the ice, one continuous mass of graphite has also been traced, 3000 yards or more in length, with an ascertained depth of thirty yards. The famous mine of Borrowdale is almost exhausted. Considerable quantities are, however, procured from Ceylon and Austria, as well as some from Spain, Mexico, Greenland, and the Cape Colony. Besides its common uses, plumbago is of great utility in the manufacture of crucibles for metallurgical and chemical purposes.

Among mineral productions available as articles of utility and commerce, mention must not be omitted of some that are of great use in agriculture, especially in such farming as must be carried on in densely-peopled countries, where all qualities of soil must be brought under cultivation. In addition to the silica, alumina, and lime, which are the common chemical constituents of arable soils, there must be a due supply of salts of potash, phosphoric acid, nitrogen, and some other ingredients. Organic remains, in the shape of natural vegetable decay and of ordinary farm manures, supply these; but mineral manures are also highly valuable and much used. Limes, clays, sands, marls are all useful under certain circumstances. Saltpetre (nitrate of potash) is a valuable addition to soils requiring nitrogen, but it is costly. The cubic nitre already alluded to exists, however, in great abundance, and is largely available for the same purpose. Phosphates of lime are used to furnish the phosphoric acid. The supply is now chiefly obtained from the

small hard nodules of various sizes, composed, in part, of ancient organic remains—*coprolites*—which are found in the Crag of Suffolk, and in the Greensand at Farnham, Cambridge, Hitchin, Isle of Wight, Havre and other parts of France. Phosphatic nodules are also abundant in the Lias. Thousands of tons of these are annually raised, crushed, and, by the action of sulphuric acid, converted into superphosphates of lime; and they are, in this form, extensively employed for manure. Phosphate of lime is quarried in Spain, and at Sombrero, one of the West Indian Isles, and prepared for agricultural purposes.

## PRECIOUS STONES.

A few minerals, on account of their rarity, splendour, and value, are known as precious stones or gems. They are met with in veins, and also, as with some of the metals and their ores, in river sands and alluvial deposits brought down from the mountain districts. Brazil, India, the Ural Mountains, and the mining regions in general, especially those of the older formations, furnish the chief supply. Precious stones are either carbonaceous, aluminous, or silicious. The *Diamond* is the only one consisting solely of carbon, of which it is a surpassingly pure example, being the hardest and most valuable gem. Diamonds are prized according to their purity and freedom from colour, or if coloured, according to the depth of the tint. Distinctive for their beauty and wondrous play of light, they bear the further characteristic descriptive of "brilliants," the finest qualities being said to be of the first water, and some of the most notable treasures in the regalia of monarchs bear poetical names, such as the Kohinoor, or Mountain of Light, brought from the Punjab, and now the property of the Queen of England. By unskilful cutting, the Kohinoor

was reduced from 800 carats to 279, and then left imperfect. Since being presented to Queen Victoria it has been recut, and now weighs 102¼ carats. The great diamond in the Russian sceptre weighs, as we are told, 193 carats, and cost over £100,000, while twenty times that amount has not been thought an unreasonable value for the Kohinoor. The largest diamond known was brought from Brazil in 1728, and has been estimated at almost any value between several millions and half a million sterling. Another Brazilian diamond, the "Star of the South," was found in 1855, of the weight of 254½ carats, which was, however, diminished in cutting by one-half.

The excessive loss of weight is due to the fact that diamonds can only be cut to advantage in the plane of their cleavage. They are cut by the aid of their own dust Rough diamonds, not admitting of being cut, are set in the diamond-boring machines. Besides their extensive use for ornamental purposes, they are, in the form of fragments, of much service in the arts—as in glass-cutting, watch-making, and diamond polishing. The aluminous gems comprise the *Sapphires;* the red sapphire, or oriental *Ruby*, next in value to the diamond; the blue, or true *Sapphire;* the green, or oriental *Emerald;* and the yellow, or oriental *Topaz;* the *Corundum*, or adamantine spar, the hardest substance next to diamond, and employed for emery-powder; the rubie, of various reds; the *Topaz* of various yellows; and the *Garnets*, of which the carbuncle is the choicest. The *Emerald*, of a beautiful green, and the *Beryl*—yellow, blue, or colourless—are compounds of silica, alumina, and glucina. The most valuable of the silicious gems are the *Amethyst*, of a purplish-violet hue; the *Cairngorm* stone, the *Opal*, *Sardonyx*, *Agate* (which is also employed as a burnisher), *Chalcedony*, *Carnelian* and *Jasper*. The *Lapis-lazuli*, from which ultramarine used to be prepared, is a beautiful mineral,

found in China, Persia, and Siberia. The *Turquoise* may be considered as a phosphate of alumina, lime, and silica, with iron and copper. The chief supply is drawn from the Peninsula of Sinai, which appears to have been the great mining district of the ancient Egyptians. The turquoises occur more or less in veins of sandstone.

# APPENDIX.

## VOCABULARY OF THE NAMES OF NATURAL PRODUCTIONS IN THE PRINCIPAL EUROPEAN AND ORIENTAL LANGUAGES.

| | | | |
|---|---|---|---|
| *Ags.* | Anglo-Saxon. | *Hind.* | Hindoostanee. |
| *Arab.* | Arabic. | *It.* | Italian. |
| *Bali.* | Bali. | *Jav.* | Javanese. |
| *Beng.* | Bengali. | *Lat.* | Latin. |
| *Chin.* | Chinese. | *Mal.* | Malay. |
| *Cing.* | Cingalese. | *Pers.* | Persian. |
| *Da.* | Danish. | *P.* | Portuguese. |
| *Du.* | Dutch. | *R.* | Russian. |
| *F.* | French. | *Sans.* | Sanscrit. |
| *G.* | German. | *Sp.* | Spanish. |
| *Gr.* | Greek (Modern). | *Tam.* | Tamul. |
| *Guz.* | Guzurati. | *Turk.* | Turkish. |

THE languages are arranged in the following order:—English, French, Italian, Spanish, Portuguese, German, Dutch, Danish, Swedish, Russian, Modern Greek, Arabic (with Turkish when given), Persian, Sanscrit, Hindoostanee (Guzurati and Bengali, when distinct), Tamul, Cinghalese, Malay, followed occasionally by Javanese, Bali, Chinese.*

In order to be useful in suggesting something of the history of the object, or the history of its diffusion, a few etymologic additions have been made, within parentheses, consisting of the (*Ags.*) Anglo-Saxon root of the English word, when such existed, and of the Latin, as being

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often the source of the English name, and generally of those in the Romance languages. In the case of words that have come from remote sources by a circuitous route, this is compendiously indicated thus—*Greek* through *Latin*, *Arabic* through *Spanish*, &c. Articles of which the English name is directly from the Anglo-Saxon, may be assumed to have been known in this island before the tenth century. If the Anglo-Saxon form agrees with the other Teutonic languages, and is distinct from the Latin, it may be assumed that the object was known to our ancestors before they entered Britain, *e.g.*, gold, wheat, clover; if the Anglo-Saxon is a mere variant of the Latin, it may be assumed that the knowledge of the object was attained by our ancestors, in Britain, from Latin sources, *e.g.*, turnip, vinegar. The names of Eastern origin have come chiefly through three routes—first, those of which a knowledge was acquired by the ancient Greeks from the Arabs, Persians, or Indians, *e.g.*, sugar, galbanum; secondly, those of which a knowledge was communicated by the Arabs in Spain to the Spanish and Portuguese—a numerous class of productions—*e.g.*, saffron, turmeric, artichoke, orange; lastly, those taken directly, in the modern period, from Hindoostanee, Malay, Chinese, &c., *e.g.*, tea, rattan, banian, banana.

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AGATE (*Lat.* achates; *Gr.* αχάτης).—*F.* agate; *It.*, *Sp.*, *P.* agata; *G.* Achat; *Du.* agaat; *Da.* agatsteen; *Sw.* agat; *Gr.* ἀχάτης; *R.* агатъ, aghát'; *Hind.*, *Guz.* akeek.

ALABASTER (*Gr.* αλάβαστρον).—*F.* albâtre; *It.*, *Sp.*, *P.* alabastro; *G.* Alabaster; *Du.* albast; *Da.* alabast; *Sw.* alabaster; *Gr.* ἀλάβαστρον; *R.* алебастръ, alebástr'; *Hind.* murmur.

ALCOHOL, SPIRIT OF WINE (*Arab.* al kohol).—*F.* alcool, esprit de vin; *It.* spirito di vino; *Sp.* alcohól (espiritu rectificado); *P.* alcohol; *G.* rectificirter Weingeist; *Du.*, *Da.* alcohol; *Da.* rectificeret Spiritus Vini; *Sw.* alkohol; *R.* самый чистый спиртъ, samyĭ tshīstyĭ sprīt.

ALKALI (*Arab.* al kali).—*F.* alcali, soude; *It.*, *Sp.*, *P.* alcali; *G.* Alkali, Laugensalz; *Du.* loogzout; *Da.* ludsalt; *Sw.* alkali, lutsalt; *Gr.* αλκάλιον; *R.* щелокъ, shtshelók; *Hind.*, *Guz.* khar.

ALMOND,-S (*Lat.* amygdalum, *from Gr.* αμύγδαλον).—*F.* amande,-s; *It.* mandorla,-e; *Sp.* almendra,-s; *P.* amendoa,-s; *G.* Mandel,-n; *Du.* amandel,-n; *Da.*, *Sw.* mandel; *Gr.* αμύγδαλον; *R.* миндалина, mīndálīna; *Arab.* louz; *Pers.*, *Hind.*, *Guz.* buddam; *Sans.* inghurdi; *Tam.* parsie vadomcotty; *Cing.* Waloo luway; *Mal.* louzan; *Jav.* kateping.

ALOES (*Gr.* αλοή, *through Lat.*).—*F.* aloès; *It.*, *Sp.*, *P.* aloe; *P.* azevre;

*G.*, *Du.*, *Da.*, *Sw.* aloe; *Gr.* αλοή; *R.* сабуръ, sabúr; *Arab.* mucibar; *Per.* sibbir; *Hind.* alia; *Tam.* carriaboolum; *Cing.* comarika; *Mal.* uloo-watan.

ALUM (*Lat.* alumen).—*F.* alun; *It.* allume; *Sp.* alumbre; *P.* pedra hume; *G.* Alaun; *Du.* aluin; *Da.* allun; *Sw.* alun; *Gr.* στύψη, στύψις; *R.* квасцы, kvastsý; *Arab.* shebb; *Pers.* zajbeluir; *Hind.* phutkee, phutkurrie; *Guz.* phutkee; *Sans.* puttaki; *Tam.* paddicarum; *Cing.* chinakarum.

AMBER (*Arab.* anbar, *through Spanish; Lat.* succinum.)—*F.* succin, ambre jaune; *Sp.* ambar; *P.* ambre, ambar; *It.* ambra gialla; *G.* Bernstein; *Du.* barnsteen; *Da.* rav; *Sw.* bernsten; *R.* янтарь yantár'; *Arab.* kernulbheir; *Pers.* karuba; *Hind.* kepoor, umbir; *Tam.* umbir; *Cing.* ambra; *Mal.* ambur.

AMBERGRIS.—*F.* ambre gris=grey amber; *It.* ambracane, ambragrisea; *Sp.*, *P.* ambargris; *G.* Ambra; *Du.* ambergrijs; *Da.*, *Sw.* ambra; *Gr.* ἄμβρα; *R.* амбра, ámbra; *Arab.* anbar; *Pers.* shahboi; *Hind.* umber; *Sans.* ambara; *Tam.* min-umbir; *Cing.* mussumbra; *Mal.* anbar.

AMETHYST (*Lat.* amethystus, *from Gr.* ἀμέθυστος).—*F.* amethyste; *It.*, *Sp.* amatista; *P.* ametista; *G.* Amethyst; *Du.* amethist; *Da.* amethyst; *Sw.* ametist; *Gr.* ἀμέθυστος; *R.* вишневый лалъ, vīshnévyĭ lal; аметистъ, ametíst.

AMMONIACUM, GUM AMMONIAC (*Gr.*, *through Lat.*).—*F.* gomme ammoniaque; *It.*, *P.* gomma ammoniaco; *Sp.* goma amoniaco; *G.* Ammoniack; *Du.*, *Da.*, *Sw.* ammoniak; *Gr.* ἀμμονιακὸν; *Arab.* feshook, ushek; *Pers.* semnugh-bil-shereen; *Hind.* astruck.

AMMONIAC, SAL. *See* Sal Ammoniac.

ANCHOVY.—*F.* anchois; *It.* acciuga; *Sp.* anchoa; *P.* anchova; *G.* Anschove; *Du.* ansjovis; *Da.* anchovis; *Sw.* anjovis; *Gr.* αντζόϊα; *R.* анчоусъ, antshöúss.

ANISE SEED (*Lat.* anisum).—*F.* graines d'anis; *It.* anice; *Sp.*, *P.* anis; *G.* Anis; *Du.* anijs; *Da.*, *Sw.* anis; *R.* анисъ, aníss; *Gr.* ἄνισον; *Arab.* anison; *Pers.* razyeaneh-roomie; *Sans.* sataphuspha; *Hind.* anise; *Guz.* anisu; *Tam.* sumbu; *Mal.* jeeramanis; *Jav.* mungfi, adis-manis.

ANTIMONY (*Gr.*, *through Lat.*).—*F.* antimoine; *It.*, *Sp.*, *P.* antimonio; *G.* Spiessglanz; *Du.* spiesglas; *Da.* spidsglans; *Sw.* spetsglans; *Gr.* αντιμόνιον; *R.* антимонія, antīmóniya; *Arab.* ismud; *Pers.* surmah; *Sans.* sauvira; *Hind.* ungen; *Guz.* surmah; *Tam.* anjana kaloo; *Mal.* surmah.

APPLE (*Ags.* æppel; *Lat.* malum, pomum).—*F.* pomme; *It.* mela, pomo; *Sp.* manzána; *P.* maçãa; *G.* Apfel; *Du.* appel; *Da.* æble; *Sw.* äple; *Gr.* μῆλον; *R.* яблоко, yábloko.

APRICOT (*Lat.* arbor præcocia, *through Sp. and F.*)—*F.* abricot; *It.* albicocco; *Sp.* albaricóque, damasco; *P.* albricoque, damasco; *G.* Apricose; *Du.* abrikoos; *Da.*, *Sw.* apricos; *Gr.* βερίκοκον, καΐσιον; *R.* курега, kurégha.

ARNOTTO, ANNATO.—*F.* rocou; *It.* ariana; *Sp.* arellana, achiote; *P.* oriana; *G.* Orlean; *Du.* orleaan, rokoe; *Sw.* orleana.

ARRACK (*Hind.*).—*F.* arac, rack; *It.* arrac, araco; *Sp.* araca, aguardiente de azucar; *P.* araca; *G.*, *Sw.* arack, rack; *Du.*, *Da.* arak; *R.* рака, raká; *Hind.* arrack.

ARROW-ROOT (*Lat.* maranta). — *F.* herbe à la flèche; *Sp.* maranta; *G.* Pfeilwurz; *Du.* pijlkruid; *Da.* salep; *Hind.* tikhur; *Tam.* kooamaoo.

ARSENIC (*Gr.* ἄρσην, strong, having virtue).—*F.* arsénic; *It.*, *Sp.*, *P.* arsénico; *G.* Arsenik; *Du.* rottekruid; *Da.* arsenik; *Sw.* arseník; *Gr.* αρσενικόν; *R.* мышьякъ, myshyáck; *Arab.* turabul halil; *Hind.* sunchya; *Tam.* vullay pashanum; *Mal.* wrongon.

ARTICHOKE (*Arab.*, *through Sp. and F.*).—*F.* artichaut; *It.* carciofo; *Sp.* alcachófa; *P.* alcachofra; *G.* Artischocke; *Du.* artisjok; *Da.* artiskok; *Sw.* ärtskocka; *Gr.* αγκινάρα; *R.* артишокъ, artishókk.

ASARABACCA (*Lat.* asarum).—*F.* assaret; *It.*, *Sp.* asarabacara, asaraca; *P.* asarabacara, assarabacca; *G.* Haselkraut; *Da.* hasselurt; *Sw.* hasselört; *R.* асаронъ, assarón; *Gr.* ἄσαρον; *Arab.* asaroon; *Sans.* oopana; *Hind.* tuckir; *Tam.* mootricunjayvie.

ASBESTUS (*Gr.*, α, not; σβεω, to consume).—*F.* asbeste, amianthe; *It.* amianto; *Sp.*, *P.* asbesto, amianto; *G.* Asbest; *Du.* steenvlas; *Da.* steenhör; *Sw.* asbest; *Gr.* αμιάντος, σμίγουσα; *R.* каменный ленъ, kámmenyĭ lyónn—*i.e.*, stone flax.

ASH (*Ags.* æsc; *Lat.* fraxinus).—*F.* frêne; *It.* frassino; *Sp.* fresno; *P.* freixo; *G.* Esche; *Du.* esschen-boom; *Da.* aske-træ; *Sw.* ask-träd; *Gr.* φράξος; *R.* ясень, yassen'.

ASPARAGUS (*Lat.*).—*F.* asperge; *It.* aspárago; *Sp.* esparrago; *P.* espargo; *G.* Spargel; *Du.* aspergie; *Da.* asparges; *Sw.* sparris; *Gr.* σπαράγγιον, ἀσπάραγος; *R.* холодецъ, cholodéts, спаржа, sparzha.

ASPHALTUM (*Gr.*, *through Lat.*).—*F.* asphalte; *It.*, *Sp.* asfalto; *P.* asphalto; *G.* Judenpech, Bergpech; *Du.* jodenlijm; *Da.*, *Sw.* asphalt; *Gr.* ἄσφαλτος; *R.* горная смола, ghórnaya smolá.

ASS (*Ags.* assa, asal, *from Lat.* asinus).—*F.* âne; *It.* asino; *Sp.* asno; *P.* asno, burro; *G.* Esel; *Du.* ezel; *Da.* asen, æsel; *Sw.* åsna; *Gr.* ὄνος, γάϊδαρος; *R.* оселъ, ossyóll.

ASSAFŒTIDA (*Lat.*).—*F.* asafœtida; *It.* assafetida; *Sp.* asafetida; *P.* assafetida; *G.* Teufelsdreck; *Du.* duivelsdrek; *Da.* dyvels-

dræk; *Sw.* dyfvelsträk; *Arab.* hilteeth; *Pers.* ungoozeh; *Sans.* hinga, hingu; *Hind.* hing; *Tam.* perungyum; *Mal.* angu.

BACON.—*F.* lard; *It.* lardo; *Sp.* tocino; *P.* toucinho; *G.* Speck *Du.* spek; *Da.* flæsk; *Sw.* fläsk; *Gr.* λαρδίον; *R.* ветчина, vetshiná.

BALLAST (*Da., through Du.*).—*F.* lest; *It.* stiva, zavorra; *Sp.* lastre; *P.* lastro; *G., Du.* Ballast; *Da.* ballast, baglast (*i.e.*, back-load); *Sw.* barlast (*i.e.*, bare-load); *Gr.* σαβοῦρα; *R.* баластъ, balást; *Hind.* neerum.

BALSAM (*Lat.* balsamum, *from Gr.* βαλσαμον.)—*F.* baume; *It., Sp., P.* bálsamo; *G.* Balsam; *Du.* balsem; *Da.* balsam; *Sw.* balsam; *Gr.* βάλσαμον; *R.* мазъ, mazz, бальзамъ, bal'zam.

BAMBOO (*Lat.* bambusa).—*Fr.* bambou; *It.* bambu; *Sp.* bamboa; *P.* bambu; *G.* Bambus; *Du.* bamboes; *Da.* bambus-rör; *Sw.* bamburör; *R.* бамбукъ, bambúk, индійская тросmь, īndíĭskaya trost'; *Hind.* bumboo; *Mal.* buluh; *Jav.* preng.

BANANA.—*F.* banane; *It., Sp., P.* banana; *Sp.* plátano; *G.* Paradiesfeige, Pisang; *Du.* pisangboom; *Da.* bananer, pisang; *Sw.* bananas träd; *Sans.* kudali; *Hind,* kayla; *Tam.* valiepullum; *Cing.* kehl-kang; *Mal.* pesang; *Jav.* gadang.

BARILLA (*Sp.*).—*F.* barille; *It., Sp.* barilla; *P.* barrilha; *G.* Spanische Soda; *Du.* barillaloogzout; *Da.* barilla, Spansk soda; *R.* соцянка, sotsyanka; *Arab.* kali; *Hind.* sajeekhar.

BARK (*Da., Ags.* rind; *Lat.* cortex).—F. écorce; *It.* scorza; *Sp.* corteza; *P.* casca; *G.* Rinde; *Du.* schors; *Da.* bark; *Sw.* bark; *Gr.* φλοῦδα; *R.* коря, korya; *Arab.* kusher; *Hind.* chal.

BARLEY (*Ags.* bere; *Lat.* hordeum).—*F.* orge; *It.* orzo; *Sp.* cebada; *P.* cevada; *G.* Gerste; *Du.* gerst; *Da.* byg; *Sw.* bjugg; *Gr.* κριθάριον; *R.* ячмень, yatshmén'; *Arab.* shair, dhourra; *Pers., Hind., Guz.* jow.

BAY, or LAUREL (*Gr.* βαιον, a palm-branch?).—*F.* laurier; *It.* lauro; lauél; *P.* loureiro; *G.* Lorbeer; *Du.* laurier; *Da.* laurbærtræ; *Sw.* lager (träd); *Gr.* δάφνη; *R.* лавръ, lavr.

BEAN (*Ags.* bean).—*Lat.* faba; *F.* fève; *It.* fava; *Sp.* haba; *P.* fava; *G.* Bohne; *Du.* boon; *Da.* bönne; *Sw.* böna; *Gr.* κουκίον; *R.* бобъ, bobb.

BEECH (*Ags.* béce; *Lat.* fagus).—*F.* hêtre; *It.* faggio; *Sp.* haya; *P.* faia; *G.* Buche; *Du.* beukenboom; *Da.* bögetræ; *Sw.* bokträd; *Gr.* 'οξύα; *R.* букъ, buk.

BEEF (*Lat.* bos, bovis, *ox*).—*F.* bœuf; *It.* vaccina, manzo; *Sp., P.* vaca; *G.* Rindfleisch; *Du.* rundfleesch; *Da.* oxekjöd; *Sw.* oxkött; *Gr.* βόδιον κρέας; *R.* говядина, ghovyádīna.

BEER (*Ags.* beor, *from* bere, barley; *Lat.* cerevisia).—*F.* bière; *It.*

birra ; *Sp.* cerveza ; *P.* cerveja ; *G.* Bier ; *Du.* bier ; *Da.*, *Sw.* öl ; *Gr.* ζύθος, μπίβα ; *R.* **пиво**, pīvo.

BEET (*Lat.* beta).—*F.* betterave ; *It.* bietola ; *Sp.* acelga ; *P.* acelgas ; *G.* Beete ; *Du.* biet ; *Da.* bede ; *Sw.* beta ; *R.* **свекла**, svekla.

BENZOIN, BENJAMIN.—*F.* benjoin ; *It.* bengivi ; *Sp.* benjuì, menjuì ; *P.* beijoim ; *G.* Benzoe ; *Du.* benzoë ; *Da.*, *Sw.* benzoe ; *R.* **росной ладонъ**, rosnoĭ ladónn ; *Arab.*, *Pers.*, *Hind.*, *Guz.* luban ; *Sans.* devadhupa ; *Cing.* caloowell ; *Mal.* cominyan ; *Jav.* menjan.

BERRY (*Ags.* berige, what a tree *bears ; Lat.* bacca).—*F.* baie ; *It.* bacca ; *Sp.* baya ; *P.* baga ; *G.* Beere ; *Du.* bes ; *Da.* bær ; *Sw.* bär ; *Gr.* κούκουτζον ; *R.* **ягоды**, yághody.

BERYL (*Gr.*, *through Lat.*).—*F.* béril ; *It.* berillo ; *Sp.* beril ; *P.* berillo ; *G.* Beryll ; *Du.* berilsteen ; *Da.* beryl-steen ; *Sw.* beryl-sten ; *R.* **бериллъ**, berill.

BETEL.—*F.* bétel ; *Sp.* betél ; *P.* bethel, betere ; *G.*, *Du.* betel ; *Arab.* tambool ; *Pers.* burgi-tambul ; *Sans.* tambuli ; *Hind.* pan ; *Tam.* vettilei ; *Mal.* sireh.

BIRCH (*Ags.* beorc, byrke ; *Lat.* betula).—*F.* bouleau ; *It.* scopa ; *Sp.* abedul ; *P.* vidoeiro ; *G.* Birke ; *Du.* berk ; *Da.* birke-træ ; *Sw.* björk ; *Gr.* σημύδα ; *R.* **береза**, beréza.

BIRD-LIME (*Lat.* viscus).—*F.* glu ; *It.* vischio ; *Sp.* liga ; *P.* visco ; *G.* Vogel-leim ; *Du.* vogellijm ; *Da.* fugleliim ; *Sw.* fogellim ; *Gr.* ἰξός ; *R.* **птичій клей**, ptītshiĭ kleĭ.

BISMUTH (*Germ.*).—*F.* bismuth ; *It.*, *Sp.* bismuto ; *P.* bismuth, marcasita ; *G.* Wissmuth ; *Du.*, *Da.* bismuth ; *Sw.* bismut ; *R.* **висмутъ**, vīsmut.

BITUMEN (*Lat.*).—*F.*, *It.* bitume ; *Sp.* betun ; *P.* betume ; *G.* Erd-pech, Erdharz ; *Du.* jodenlijm ; *Da.* jordbeg ; *Sw.* jordbeck ; *R.* **горная смола**, ghornaya smolá ; *Pers.* nift-i-roomie ; *Hind.* nift-roomie.

BONE (*Ags.* bán ; *Lat.* os, ossa).—*F.* os ; *It.* osso ; *Sp.* hueso ; *P.* osso ; *G.* Knochen ; *Du.* been ; *Da.* been ; *Sw.* ben ; *Gr.* κόκκαλον ὀστέον ; *R.* **кость**, kost' ; *Pers.* istakhan ; *Hind.* huddee.

BORAX (*Lat.*).—*F.* borax ; *It.* borrace ; *Sp.* borrax ; *P.* borax, tincal ; *G.*, *Du.*, *Da.*, *Sw.* borax ; *R.* **бура**, búra ; *Arab.* buruk ; *Pers.* tunkar ; *Sans.* tunkanna ; *Hind.* tunkun-khar, kuddiakhar ; *Tam.* velligarum, vengarum ; *Cing.* lansipuscara ; *Mal.* patterie, piger ; *Jav.* piger.

BOX (*Ags.* bux, *from Lat.* buxus).—*F.* buis ; *It.* bosso ; *Sp.* box ; *P.* buxo ; *G.* Buchsbaum ; *Du.* boksboom ; *Da.* buxbom-træ ; *Sw.* buxbom ; *R.* **буксъ**, buks.

BRASS (*Ags.* bræs, *from* bredan, *to bend*).—*Lat.* æs ; *F.* airain, cuivre

jaune; *It.* ottone, rame; *Sp.* laton; *P.* latão; *G.* Messing, Erz; *Du.* geel koper; *Da.*, *Sw.* messing; *R.* зеленая мѣдь, zelénaya myêd'; *Hind.* peetul.

BRAZILWOOD.—*F.* bois de brésil; *It.* legno del Brasile, verzino; *Sp.* madera, palo del Bresil; *P.* pao Brasil, pao de Rainha; *G.* Brasilienholz; *Du.* Brasilienhout; *Da.* Brasilietræ; *Sw.* bresilja träd.

BRICK (*F.*).—*F.* brique; *It.* mattone; *Sp.* ladrillo; *P.* tijolo; *G.* Backstein; *Du.* baksteen; *Da.* muursteen; *Sw.* tegelsten; *Gr.* τοῦβλον; *R.* кирпичъ, kīrpítsh; *Hind.* eat.

BRISTLES (*Ags.* bristl; *Lat.* seta).—*F.* soies de cochon; *It.* setole; *Sp.* cerdas; *P.* sedas (de porco); *G.* Borsten; *Du.* borstels; *Da.* svinebörster; *Sw.* svinborst; *Gr.* γουρουνότριχα; *R.* щетины, shtshetīny.

BRONZE (*F.*).—*F.* bronze; *It.* bronzo; *Sp.* bronce; *P.* bronze; *G.* Bronze; *Du.* brons; *Da.* bronce; *Sw.* brons; *R.* бронза, желтая мѣдь, bronza, zhéltaya myêd'.

BUCKWHEAT.—*F.* blé sarrasin, blé noir; *It.* grano nero, sarracino; *Sp.* trigo negro, sarraceno; *P.* trigo sarraceno; *G.* Buchweizen, Heidekorn; *Du.* boekweit; *Da.* boghvede; *Sw.* bokhvete; *R.* гречиха, ghretshīha.

BUTTER (*Ags.* butyre, *from Lat.* butyrum).—*F.* beurre; *It.* butirro; *Sp.* manteca; *P.* manteiga; *G.* Butter; *Du.* boter; *Da. Sw.* smör; *Gr.* βούτυρον; *R.* масло, maslo; *Hind.* muska, mucken.

CACAO, or COCOA (*Caribb.*).—*F.* cacao; *It.* caccao; *Sp.*, *P.* cacáo; *G.*, *Du.* Cacao; *Da.*, *Sw.* kakao; *Gr.* κάκαον; *R.* какао, kakao.

CABBAGE (*corruption of Brassica* capitata *or* capitagium ?).—*F.* chou; *It.* cávolo; *Sp.* berza, col; *P.* couve, repolho; *G.* Kohl; *Du.* kool; *Da.* kaal; *Sw.* kål; *Gr.* λάχανον; *R.* капуста, kapústa.

CALABASH.—*F.* calebasse; *It.* zucca; *Sp.* calabaza; *P.* calabaça; *G.* Calabasse; *Du.* kalebas; *Da.* kalabas, flaskegræskar; *Sw.* kalebass; *R.* горлянка, ghorlyánka.

CALCEDONY (*Gr.*, *through Lat.*, *from* City of Chalcedon).—*F.* calcédoine; *It.*, *Sp.*, *P.* calcedonia; *G.* Chalcedonien; *Du.* chalcedon; *Da.* khalkedón; *Sw.* Kalcedon; *Gr.* χαλκηδών; *R.* халкедонъ, khalkedón; *Hind.* akeek.

CAMEL (*Heb.*, *through Gr. and Lat.* Camelus).—*F.* chameau; *It.* cammello; *Sp.* camello; *P.* camelo; *G.*, *Du.*, *Da.* Kameel; *Sw.* kamel; *Gr.* καμήλα; *R.* верблюдъ, verblyúd.

CAMPHOR (*Sans.*, *Gr.*, *Lat.*).—*F.* camphre; *It.* cánfora; *Sp.* alcanfor; *P.* alcanfor, camphora; *G.* Kampfer; *Du.* kamfer; *Da.* campher; *Sw.* kamfer; *Gr.* κάμφορα; *R.* камфора, kámfora; *Arab.*, *Pers.* kafoor; *Sans.* kapūr; *Hind.*, *Guz.* kumfoor; *Tam.* carpoorum; *Cing.* capooroo; *Mal.* kaafur.

CANE (*Lat.* canna; *Gr.* καννα, *from Heb. and Arab.*).—*Fr.* canne; *It.* canna; *Sp.* caña; *P.* canna; *G.* Rohr; *Du.* rotting; *Da.* rör; *Sw.* rör; *Gr.* κάλαμος; *R.* камышъ, трость, kamýsh, trost'; *Hind.* bhate; *Guz.* nathur.

CANTHARIDES (*Gr.* κανθαρὶς, *through Lat.*).—*F.* cantharide; *It.* cantaridi, canterelle; *Sp.* cantaridas; *P.* cantharidas; *G.* spanische Fliegen; *Du.* spaansche vliegen; *Da.* spanske fluer; *Sw.* spanska flugor; *Gr.* κανθαρίδια; *R.* Шпанскія мухи, Shpánskiä múkhī.

CAOUTCHOUC.—*See* India-rubber.

CAPERS (*Gr.*, *Lat.*)—*F.* câpre; *It.* cappero; *Sp.* alcaparro; *P.* alcaparra; *G.* Kaper; *Du.* Kapper; *Da.* kapers; *Sw.* kapris, capers; *Gr.* κάππαρη; *R.* каперсы, kápersy; *Arab.* kebbir.

CAPSICUM. — *F.* feuille de piment; *Sp.* pimiento; *P.* pimenta; *G.* spanischer Pfeffer; *Du.* spaansche peper; *Da.* Spansk peber; *Sw.* Spansk peppar; *Hind.*, *Guz.* mirchee; *Mal.* chubui; *Jav.* lombok.

CARAWAY (*Lat.* carum).—*F.*, *It.* carvi; *Sp.* alcaravea; *P.* caravea, chirivia; *G.* Feldkümmel; *Du.* karrewei; *Da.* dansk kummin; *Sw.* kummin; *Gr.* κύμινον; *R.* киминъ, kīmín, тминъ, tmīn.

CARDAMOMS.—*F.* cardamomes; *It.* cardamomi; *Sp.*, *P.* cardamomos; *G.* Kardamom; *Du.* kardamomen; *Da.* kardemomme; *Sw.* Kardemumma; *Gr.* καρδάμωμοι; *Arab.* ebil, heelbuya; *Pers.* kakelahsegar; *Hind.*, *Guz.* ealchee; *Tam.* yaydersie; *Cing.* ensal; *Mal.* capalaga; *Jav.* kapol.

CARROT (*Lat.* carota, *from Celtic*).—*F.* carotte; *It.* carota; *Sp.* zanahoria; *P.* cenoura; *G.* Möhre; *Du.* gele Wortel; *Da.* gulerod; *Sw.* morot; *Gr.* δαῦκος; *R.* морковь, morkóv'.

CASTOR (*Lat.* castor, *the beaver*).—*F.*, castoréum; *It.* castora; *Sp.*, *P.* castoreo; *G.* Bibergeil, Castor; *Du.* bevergeil; *Da.* bævergel; *Sw.* kastor, bäfwer-gall; *Gr.* καστόρχιον; *R.* бобровая струя, bobrovaya struyá; *Arab.* ashbutchegan; *Pers.* joond-bedushtar.

CASTOR-OIL (*Lat.* oleum Ricini.)—*F.* huile de Ricin; *Sp.* aceite de palma cristi; *P.* oleo de mamona, de ricino; *G.* Ricinus-öl; *Du.* ricinus-olie; *Da.* Amerikansk olie; *Hind.* errundee-ka-teil.

CATECHU, CUTCH.—*F.* cachou; *It.* catecu; *Sp.* tierra Japonica; *P.* catch; *G.* Katchu; *Hind.*, *Guz.* cutch, cuth, couth; *Mal.* gambir.

ÇAVIAR.—*F.* caviar; *It.* caviale; *Sp.* cabial; *P.* ovas escaladas; *G.* Kaviar; *Du.* kaviaar; *Da.* caviar; *Sw.* kaviar; *Gr.* χαβιάριον; *R.* икра, īkrá.

CEDAR (*Lat.* cedrus, *from Greek*).—*F.* cèdre; *It.*, *Sp.*, *P.* cedro; *G.* Ceder; *Du.* ceder; *Da.* ceder-træ; *Sw.* ceder-träd; *Gr.* κέδρος; *R.* кедръ kedr.

CELERY.—*F.* céleri; *It.* selleri; *Sp.* apio; *P.* apio hortense; *G.* Sellerie; *Du.* selderij; *Da.*, *Sw.* selleri; *R.* сельдерей, sel'deréï.

CEMENT (*Lat.*).—*F.* ciment; *It.*, *Sp.* cimento; *P.* cemento; *G.*, *Du.*, *Da.*, *Sw.* Cement; *Gr.* κόλλα, πετρόκολλα; *R.* клей, kleï.

CHALK (*Ags.* cealc, cálc, *comp. Lat.* calx, *lime; Lat.* creta).—*F.* craie; *It.* creta, gesso; *Sp.* greda; *P.* greda; *G.* Kreide; *Du.* krijt; *Da.* kridt; *Sw.* krita; *Gr.* κυμωλία; *R.* мѣлъ, myêll; *Arab.* tyn-abyaz; *Hind.* kurroo; *Tam.* simie-chunamboo; *Mal.* capoor-engrees; *Cing.* ratta-hoonoo.

CHAMOMILE (*Lat.* chamomilla, *from Gr.* χαμομίλλα).—*F.* camomille; *It.* camomilla; *Sp.* manzanilla; *P.* macella; *G.*, *Du.*, *Da.* Kamille; *Sw.* kamillblomster; *Gr.* χαμόμηλα; *R.* ромашка, romáshka; *Arab.* ehdahkl-mirzie; *Pers.* baboonch-gow; *Hind.* baboone-kaphul; *Tam.* chamaindoo-poo.

CHARCOAL (cear-coal; *i.e.*, turned coal, coal turned or converted from something else).—*Lat.* carbo; *F.* charbon (de bois); *It.* carbone (di legna); *Sp.* carbon (de leña); *P.* carvão (de lenha); *G.* Holzkohle; *Du.* houtskool; *Da.* trækul; *Sw.* brännkol; *Gr.* ξυλοκάρβουνον; *R.* дровяной уголь, drovyánnoï ughol'; *Arab.* fuhm-chobie; *Pers.* zeghal-i-chobie; *Hind.* koo-e-la; *Tam.* adapoo-karrie; *Cing.* lippe-anghoroo.

CHEESE (*Ags.* cyse, cese; *Lat.* caseus).—*F.* fromage; *It.* formaggio, cacio; *Sp.* queso; *P.* queijo; *G.* Käse; *Du.* kaas; *Da.*, *Sw.* ost; *Gr.* τυρίον; *R.* сыръ, syrr; *Pers.*, *Hind.*, *Guz.* paneer.

CHERRY (*Lat.* cerasus; *Ags.* cirse).—*Fr.* cerise; *It.* ciriegia; *Sp.* cereza; *P.* cereja, jinja; *G.* Kirsche; *Du.* kers; *Da.* kirsebær; *Sw.* kersbär; *Gr.* κέρασον; *R.* вишня, vîshna.

CHESTNUT (*Lat.* castanea).—*F.* chataîgne; *It.* castagna; *Sp.* castaña; *P.* castanha; *G.* Kastanie; *Du.* kastanje; *Da.* castanie; *Sw.* kastanje; *Gr.* κάστανον; *R.* каштанъ, kashtánn.

CHICORY (*Lat.* cichorium; *Gr.* κιχώριον).—*F.* chicorée; *It.* cicorea; *Sp.* achicória; *P.* chicoria; *G.* Chicorie, Wegwart; *Du.* cichorei; *Da.* cicorie; *Sw.* cikorie; *Gr.* πικραλίδα; *R.* цикорей, tsikóreï.

CHINA ROOT.—*F.* esquine, squine; *Sp.* cocolmeca, raiz china; *P.* esquina; *G.* China-wurzel; *Du.* China-wortel; *Da.* China-rod; *Sw.* kina-rot; *R. Arab.* khusb-sinie; *Hind.* choob-cheenee; *Beng.* shook-china; *Tam.* Paringay-putty; *Cing.* China-alla.

CHOCOLATE (*F.*).—*F.* chocolat; *It.* cioccolato; *Sp.*, *P.* chocolate; *G.* Schokolate; *Du.*, *Da.* chocolade; *Sw.* choklad; *R.* шоколадъ, shokoládd.

CHRYSOLITE (*Lat.* chrysolithus, *from* χρυσόλιθος, *gold-stone*, in allusion to colour).—*F.* chrysolithe; *It.*, *Sp.* crisólito; *P.* crysolita;

*G.* Chrysolith; *Du.* chrysoliet; *Da.* Krysolit; *Sw.* krysolit; *Gr.* χρυσόλιθος; *R.* златокамень, zlatokamen'.

CHRYSOPRASE (*Lat.* chrysoprasus, *from Gr.* χρυσόπρασος).—*F.* chrysoprase; *It.*, *Sp.* crisoprasio; *P.* chrisopraso; *G.* Chrysoprasus; *Du.* chrysopraas; *Da.* chrysopras; *Sw.* krysopras; *Gr.* χρυσόπρασος; *R.* хрисопрасъ, khrisoprάss.

CIDER (*Fr.*)—*F.* cidre; *It.* sidro; *Sp.* sidra; *P.* cidra; *G.* Cider, Apfelwein; *Du.* appeldrank; *Da.* æblemost; *Sw.* cider, äpelwin; *Gr.* σίκερα; *R.* яблоневка, yablonévka.

CINNABAR (*Arab.* zanjifrah; *Gr.* κιννάβαρι; *Lat.* cinnabari).—*F.* cinabre; *It.* cinnabaro; *Sp.*, *P.* cinabrio; *G.* Zinnober; *Du.* vermiljoen; *Da.* cinnober; *Sw.* cinober; *Gr.* κολκιναβάριον; *R.* киноварь, kinovár; *Arab.* zunjefer; *Pers.* shengherf; *Sans.* inghulam; *Hind.*, *Guz.* hingda, durdar; *Tam.* enghilicum, shadilengum; *Mal.* sedilengam.

CINNAMON (*Heb.*, *Arab.*, *Gr.*, *Lat.*).—*F.* cinnamome, cannelle; *It.* cinnamomo, cannella; *Sp.* canela; *P.* canella, cinamomo; *G.* Zimmt, Caneel; *Du.*, *Da.* kaneel; *Sw.* kanel; *Gr.* κανέλλα, κιννάμωμον; *R.* корица, korītsa; *Arab.* darsini; *Sans.* darasita; *Pers.* dalchenee; *Hind.* tuj; *Tam.* carruwa puttay; *Mal.* kaimanis; *Cing.* kurundu.

CLAY (*Ags.* clæg—*i.e.*, that which clogs or cleaves; *Lat.* argilla).—*F.* argile; *It.* argilla; *Sp.* arcilla; *P.* barro; *G.* Lehm, Thon; *Du.* klei, leem; *Da.* leer; *Sw.* ler; *Gr.* πηλός; *R.* глина, ghlīna.

CLOVE (*from Lat.* clavis, *a nail*, in allusion to shape).—*F.* clou de girofle; *Sp.* clavo; *P.* cravos; *G.* Krautnagel (=vegetable nails); *Du.* kruidnagel; *Da.* nellike; *Sw.* (krydd)neglika; *R.* гвоздика, ghvozdīka; *Gr.* καρυόφυλλον; *Arab.* kerenful; *Pers.* meykhek; *Sans.* lavanga; *Hind.* luvung; *Tam.* craumboo; *Cing.* warrala; *Mal.* chankee; *Jav.* woh-kayu-lawang; *Bali*, buwahluvung; *Chin.* theng-hio.

CLOVER (*Ags.* clæfre; *Lat.* trifolium).—*F.* trèfle; *It.* trifoglio; *Sp.* treból; *P.* trifolio; *G.* Klee; *Du.* klaver; *Da.* klöver; *Sw.* klöfwer; *Gr.* τρίφυλλον; *R.* кашка, kashka, клеверъ, klevérr.

COAL (*Ags.* cól; *Lat.* carbo=charcoal).—*F.* charbon (de terre), Houille; *It.* carbone (fossile); *Sp.* carbon (de piedra); *P.* carvão (de pedra); *G.* Kohle, Steinkohle; *Du.* kool; *Da.* kul; *Sw.* kol, stenkol; *Gr.* (πετρο)καρβουνον; *R.* (каменный) уголь, (kámenniĭ)ughol'; *Hind.*, *Guz.* welaety-kooela.

COBALT (*Ger.*).—*F.* cobalt; *It.*, *Sp.*, *P.* cobalto; *G.*, *Du.*, *Da.* Kobalt; *Sw.* kobolt; *R.* кобальтъ, kóbal't.

COCHINEAL (*Lat.* coccinellus, *dimin. of* coccineus, *from Gr.* κόκκος, scarlet). — *F.* cochenille; *It.* coccineglia; *Sp.* cochinilla; *P.*

cochenilha; *G.* Cochenille; *Du.* konzenilje; *Da.* cochenille; *Sw.* kochenill; *Gr.* κοκκινέλλα; *R.* канцелярное сѣма, kantselyárnoe syêma, кошениль, koshenille; *Pers.*, *Hind.*, *Guz.* kermij; *Tam.* cochineel poochie.

COCKLE (*Lat.* cochlea, *from Gr.* κοχλίας, a shell).—*F.* pétoncle; *It.* conchiglia; *Sp.* caracol de mar; *P.* bribigão; *G.* Herzmuschel; *Du.* kammossel; *Da.* musling; *Sw.* mussla; *G.* κογχύλιον; *R.* гребенка, ghrebeönka.

COCO, or COCOA-NUT.—*Fr.* coco; *It.* cocco; *Sp.*, *P.* coco; *G.* Cocos-(nuss); *Du.* kokos (noot); *Da.* cocos (nöd); *Sw.* kokos (nöt); *Gr.* κόκον, κοκοφόινιξ; *R.* кокос(овый орѣхъ) kokós (ovyĭ oryêkh); *Arab.* nareel; *Pers.* nargîl; *Hind.*, *Guz.* nareel, narul; *Sans.* narikela.

COD (*Lat.* gadus).—*F.* morue; *It.* baccala, baccalare; *Sp.* bacalao; *P.* bacalhão; *G.* Kabeljau; *Du.* kabeljaauw; *Da.* kabliau; *Sw.* kabiljo; *Gr.* γαδαρόψαρον, ὀνόψαρον; *R.* треска, treska.

COFFEE (*from its native country*, Caffa, *a south-western province of Abyssinia*).—*Bot. Lat.* coffea; *F.* café; *It.* caffè; *Sp.* café; *P.* café; *G.* Kaffee; *Du.* koffij; *Da.* caffe; *Sw.* kaffe; *Gr.* καφές; *R.* кофе, koffé; *Turk.* chaube; *Arab.* bun; *Pers.* kawa; *Hind.*, *Guz.* kawa, coffee; *Tam.* capie-cottay; *Cing.* copi-cotta; *Mal.* kawa.

COLOCYNTH.—*Fr.* coloquinte; *It.*, *Sp.* coloquíntida; *P.* coloquintos; *G.* Koloquinte; *Du.* bitter-appelen; *Da.*, *Sw.* coloqvint; *Turk.* dahak; *Arab.*, *Pers.* Hun-zil; *Hind.*, *Guz.* Indrain; *Sans.* indravaruni, vishala; *Beng.* makhal; *Tam.* peycoomutikai; *Cing.* titta commodoo.

COLOMBO-ROOT, or CALUMBO-ROOT.—*Fr.* racine de Columbo; *It.* radice di Columbo; *P.* raiz de Columba; *G.* Kolumba-wurzel; *Du.* Kolumbo-wortel; *Da.* Columba-röd; *Sw.* Kolumba-rot; *Hind.*, *Guz.* Kalamb-ka-jur; *Tam.* Columboo vayr; *Cing.* Kalamboo-khoo.

CONEY, or RABBIT (*Lat.* cuniculus).—*Fr.* lapin; *It.* coniglio; *Sp.* conejo; *P.* coelho; *G.* Kaninchen; *Du.* konijn; *Da.* kanin; *Sw.* kanin; *Gr.* κουνάδιον, κουνέλιον; *R.* кроликъ, królik.

COPAL.—*F.*, *Sp.*, *P.* copal; *G.* Kopal; *Du.* kopal; *Da.*; copal; *Sw.* kopal; *R.* копалъ, kopáll; *Hind.*, *Guz.* chundroos.

COPPER (*Lat.* cuprum, *i.e.*, κύπριος χαλκός, Cyprian brass, *Pliny*).—*F.* cuivre; *It.* rame; *Sp.* cobre; *P.* cobre; *G.* Kupfer; *Du.* koper; *Da.* kobber; *Sw.* koppar; *Gr.* χαλκός; *R.* (красная) мѣдь, (krasnaya) myêd'; *Arab.* nehass; *Pers.* miss; *Sans.* tamra, tamraka; *Hind.* thamba; *Tam.* shemboo; *Mal.* tambaga; *Chin.* tung.

COPPERAS (Green vitriol, sulphate of iron).—*F.* couperose, sulfate de fer; *It.* vitriolo verde, solfato di ferro; *Sp.* caparrosa, vitriolo verde; *P.* caparrosa; *G.* grüner Vitriol; *Du.* koperrood; *Da.*, *Sw.* vitriol; *Gr.* βιτριόλιον πράσινον; *R.* купоросъ, kuporóss; *Hind.* heracussie, heratootia; *Pers.* zunkur madeenee, tootiya subz; *Tam.* annabugdie; *Mal.* taroosee

CORAL (*Gr. through Lat.*).—*F.* corail; *It.* corallo; *Sp.*, *P.* coral; *G.* Koralle; *Du.* koraal; *Da.* koral; *Sw.* korall; *Gr.* κοράλλιον; *R.* кораллъ, koráll; *Arab.* besed; *Pers.* murjan; *Sans.* vidruma, prabala; *Hind.* murjan, munga; *Tam.* pavalum; *Cing.* bubulo; *Mal.* poalum.

CORIANDER-SEED (*Lat.* coriandrum).—*F.* coriandre; *It.*, *Sp.* coriandro; *P.* coentro; *G.* Koriander (saamen); *Du.*, *Da.* coriander; *Sw.* koriander; *Arab.* kezeerah; *Per.* kushnîz; *Hind.* dhunnia; *Sans.* dhanyaka; *Tam.* cottamillie; *Cing.* cotum-barroo; *Mal.* mety.

CORK (*Lat. cortex*, bark; *Suber*, the cork-tree.)—*F.* liége; *It.* sughero; *Sp.* corcho; *P.* sobreiro de cortica; *G.* Kork; *Du.* kurk; *Da.* kork; *Sw.* kork; *Gr.* φελλός; *R.* корка, пробка, korka, probka; *Hind.*, *Guz.* bhooj.

CORN (*Ags.* corn, *kindred with Lat.* granum).—*F.* blé, froment; *It.* grano, frumento; *Sp.* grano; *P.* grão; *G.* Korn; *Du.* koren; *Da.*, *Sw.* korn; *Gr.* σῖτος; *R.* зерно, жито, zerno, zhīto; *Hind.*, *Guz.* dhan.

COTTON (*Arabic*).—*F.* coton; *It.* cotone, bambagia; *Sp.* algodon; *P.* algodão; *G.* Baumwolle (tree-wool); *Du.* katoen, boomwol; *Da.* bomuld; *Sw.* bomull, kattun; *Gr.* βαμβάκιον; *R.* хлопчатая бумага, khloptshátaya bumága; *Arab.* kutun; *Pers.* pumba; *Sans.* kapasa; *Hind.* ruhie; *Guz.* ruhie, kapoos; *Mal.* kapas.

COWRIES (*Hind.*).—*F.* coris, cauris, bouges; *It.* cori, porcellane; *Sp.* bucios, zimbos; *P.* buzios, zimbos, cauris; *G.*, *Du.* Kauris; *Hind.*, *Guz.* cowrie.

CRAB (*Ags.* crabba).—*Lat.* cancer; *F.* cancer; *It.* granchio; *Sp.* cangrejo; *P.* caranguejo; *G.* Krebs; *Du.* krab; *Da.* krabbe; *Sw.* krabba; *Gr.* καραβίδα; *R.* морской паукъ, morskóĭ páük.

CRAW-FISH (Cray-fish, *corrup. of Fr.*).—*F.* écrevisse; *It.* gambero; *Sp.* cangrejo de agua dulce; *P.* caranguejo dos rios; *G.* Bachkrebs; *Du.* rivierkreeft; *Da.* krebs; *Sw.* kräfta; *R.* ракъ, rakk.

CUCUMBER (*Ags.* cucumer, *from Lat.* cucumis-eris).—*F.* concombre; *It.* cetriuolo; *Sp.* cohombro; *P.* pepino; *G.* Gurke; *Du.* komkommer; *Da.* agurk; *Sw.* gurka; *Gr.* αγγούριον; *R.* огурецъ, oghuréts.

CURRANT (Garden).—*F.* groseille à grappes ; *It.* ribes ; *Sp.* grosella ; *G.* Johannisbeere ; *Du.* aalbes ; *Da.* ribs ; *Sw.* vinbär ; *Gr.* φραγκοστάφυλον ; *R.* смородина, smoródina.

CURRANT (*from Corinth*).—*F.* raisin de Corinthe ; *It.* uvepasse di Corinto ; *Sp.* pasas de corinto ; *P.* uvas de Corintho ; *G.* Korinthen ; *Du.* krent ; *Da.* korender ; *Sw.* korinter ; *Gr.* κοραντία, κουραντία ; *R.* коринка, korinka.

CUTTLE-FISH (*Ags.* cudele ; *Lat.* sepia ; *from Gr.*).—*F.* sèche ; *It.* seppia ; *Sp.* xibia, jibia ; *P.* siba ; *G.* Blackfisch, Tintenfisch ; *Du.* inktvisch ; *Da.* blæksprutte ; *Sw.* bläckfisk ; *Gr.* σηπιά, καλαμάριον ; *R.* каракатица, karakátitsa.

DATE (*Gr.* δάκτυλος, *through Lat.*).—*F.* datte ; *It.* dáttero ; *Sp.* dátil ; *P.* támara ; *G.* Dattel ; *Du.* dadel ; *Da.* daddel ; *Sw.* dadel ; *Gr.* φοινίκιον ; *R.* финикъ, phīnīk ; *Pers.* khurma ; *Hind.* kajoor (*dried do.* kharack).

DIAMOND (*corruption of* adamant, *Gr.*).—*F.* diamant ; *It.*, *Sp.*, *P.* diamante ; *G.*, *Du.* Diamant ; *Da.* diamant ; *Sw.* demant ; *Gr.* διαμάντιον ; *R.* алмазъ, almázz ; *Arab.*, *Pers.* almas ; *Hind.* heera.

DOG (*Fr.* dogue ; *Ger.* dogge).—*Lat.* canis ; *F.* chien ; *It.* cane ; *Sp.* perro ; *P.* cão ; *G.* Hund ; *Du.* hond ; *Da.*, *Sw.* hund ; *Gr.* σκύλος, κύων ; *R.* собака, sobáka.

DOWN (*Da.*).—*F.* duvet ; *It.* piuma ; *Sp.* plumon, plumazo ; *P.* pennuyem ; *G.* Flaumfeder, Daune ; *Du.* dons ; *Da.* duun ; *Sw.* dun ; *Gr.* χνούδιον ; *R.* пухъ, pukh.

DRAGON'S-BLOOD.—*F.* sang-dragon ; *It.* dragante ; *Sp.* sangre de dragon ; *P.* sangue de dragão ; *G.* Drachenblut ; *Du.* drakenbloed ; *Da.* drageblod ; *Sw.* drakeblod ; *R.* драконова кровь, drakónova-krov' ; *Arab.* damulakhwain ; *Pers.* khuni-shavan ; *Sans.* catukamrigarakta ; *Hind.* heeraduckkun ; *Tam.* kandamoorgarittum.

DUCK (*fr. verb* to duck ; *Lat.* anas).—*F.* canard ; *It.* anitra ; *Sp.* anade ; *P.* adem ; *G.* Ente ; *Du.* eend ; *Da.* and ; *Sw.* and, anka ; *Gr.* πάπια, νῆσσα ; *R.* утка, utka.

EARTH (*Ags.* eorthe ; *Lat.* terra).—*F.* terre ; *It.* terra ; *Sp.* tierra ; *P.* terra ; *G.* Erde ; *Du.* aarde ; *Da.*, *Sw.* jord ; *Gr.* χῶμα ; *R.* земля, zemlyá.

EBONY (*Gr.*, *Lat.*, *from Heb.*).—*F.* ébène ; *It.*, *Sp.*, *P.* ebano ; *G.* Ebenholz ; *Du.* ebbenhout ; *Da.* ibenholt ; *Sw.* ebenholts ; *Gr.* ἔβενος ; *R.* эбенъ, ebben ; *Hind.* abnoos ; *Beng.* kendoo.

EEL (*Ags.* æl ; *Lat.* anguilla).—*F.* anguille ; *It.* anguilla ; *Sp.* anguila ; *P.* anguia ; *G.*, *Du.*, *Da.* Aal ; *Sw.* ål ; *Gr.* ἐγχέλιον ; *R.* угорь, ughór'.

EGG (*Ags.* æg ; *Lat.* ovum).—*F.* œuf ; *It.* uovo ; *Sp.* huevo ; *P.* ovo ; *G.*, *Du.* Ei ; *Da.* æg ; *Sw.* ägg ; *Gr.* αὐγόν ; *R.* яйцо, yaïtsó.

ELDER (*Ags.* ellen ; *Lat.* sambucus).—*F.* sureau ; *It.* sambuco ; *Sp.* sauco ; *P.* sabugueiro ; *G.* Holunder ; *Du.* vlierboom ; *Da.* hyldetræ ; *Sw.* fläder (buske) ; *Gr.* κουφόξυλον.

ELEPHANT (*Gr. through Lat.*)—*F.* éléphant ; *It.*, *Sp.* elefante ; *P.* elephante ; *G.* Elephant ; *Du.* olifant ; *Da.* elephant ; *Sw.* elefant ; *Gr.* ἐλέφαντας ; *R.* слонъ, slonn.

ELM (*Ags.* ellm ; *Lat.* ulmus).—*F.* orme ; *It.*, *Sp.*, *P.* olmo ; *G.* Ulme ; *Du.* olm ; *Da.* almtræ ; *Sw.* almträd ; *Gr.* πτελέια ; *R.* вязъ. илемъ, vyaz, īlem.

EMERALD (*Gr., through Lat. and Norman French*).—*F.* émeraude ; *It.* smeraldo ; *Sp.*, *P.* esmeralda ; *G.*, *Du.*, *Da.*, *Sw.* Smaragd ; *Gr.* σμάραγδος ; *R.* изумрудъ, смарагдъ, izumrúd, smaráght.

EMERY (*Lat.* smiris).—*F.* émeri ; *It.* smeriglio ; *Sp.*, *P.* esmeril ; *G.* Schmergel ; *Du.* amaril ; *Da.*, *Sw.* smergel ; *R.* наждакъ, nazhdák.

ERMINE.—*F.* hermine ; *It.* ermellino ; *Sp.* armiño ; *P.* arminho ; *G.* Hermelin ; *Du.* hermelijn ; *Da.*, *Sw.* hermelin ; *Gr.* κακούμιον ; *R.* горностай, ghornostaï.

FEATHERS (*Ags.* feder ; *Lat.* penna, pluma).—*F.* plume ; *It.* piume ; *Sp.*, *P.* plumas ; *G.* Federn ; *Du.*, vederen ; *Da.* fjæder ; *Sw.* fjäder ; *Gr.* πτερά ; *R.* перя, perya ; *Hind.* pur.

FENNEL (*Lat.* fœniculum).—*F.* fenouil ; *It.* finocchio ; *Sp.* hinojo ; *P.* funcho ; *G.* Fenchel ; *Sw.* fenkål ; *R.* воложскій укропъ, volozhskii ukrop ; *Arab.* razeeanuj ; *Pers.* badeeyan ; *Sans.* madhurika ; *Hind.* mayuri, wurrialee ; *Tam.* perun-siragum ; *Cing.* dewadooroo.

FIG,-S (*Lat.* ficus).—*F.* figue,-s ; *It.* fico, fichi ; *Sp.* higo,-s ; *P.* figo,-s ; *G.* Feige,-n ; *Du.* vijg,-en ; *Da.* figen ; *Sw.* fikon ; *Gr.* σῦκον,-α ; *R.* смоква-ы, smókva,-y ; *Arab.* teen ; *Pers.*, *Hind.* anjeer ; *Sans.* udumvara ; *Tam.* simie attie pullum ; *Cing.* rata attika.

FISH (*Ags.* fisc ; *Lat.* piscis).—*F.* poisson ; *It.* pesce ; *Sp.* pez ; *P.* peixe ; *G.* Fisch ; *Du.* visch ; *Da.*, *Sw.* fisk ; *Gr.* ὀψάριον ; *R.* рыба, rýba.

FLAX (*Ags.* flæcs ; *Lat.* linum).—*F.*, lin ; *It.*, *Sp.* lino ; *P.* linho ; *G.* Flachs ; *Du.* vlas ; *Da.* hör ; *Sw.* lin ; *Gr.* λινάριον ; *R.* лёнъ, leönn.

FLESH (*Ags.* flæsc ; *Lat.* caro).—*F.* chair ; *It.*, *Sp.*, *P.* carne ; *G.* Fleisch ; *Du.* vleesch ; *Da.* kjöd ; *Sw.* kött ; *Gr.* κρέας ; *R.* мясо, myåsso.

FLINT (*Ags.* flint ; *Lat.* silex).—*F.* caillou, pierre-à-feu ; *It.* selce ; *Sp.* pedernal ; *P.* pederneira ; *G.* Feuerstein ; *Du.* vuursteen, keisteen ; *Da.* flintesteen ; *Sw.* flintasten ; *Gr.* τζακουμακόπετρα ; *R.* кремень, kremen' ; *Hind.* chachmak.

FLOUR (*Lat. flos ;* flour, *Lat.* farina).—*F.* farine ; *It.* farina ; *Sp.* flor de harina ; *P.* farinha ; *G.* Mehl ; *Du.*, *Da.* meel ; *Sw.* mjöl ;

*Gr.* ἀλεύριον; *R.* мука, muká; *Hind.* atta; *Tam.* godum-bay-mao; *Cing.* tringoo-pittay.

FLOWERS (*Lat.* flores; *Ags.* blostman).—*F.* fleurs; *It.* fiori; *Sp.*, *P.* flores; *G.* Blumen; *Du.* bloemen; *Da.* blomster; *Sw.* blommar; *Gr.* ἄνθοι, λουλόυδια; *R.* цвѣтки, tsvyetky.

FURS.—*F.* fourrure; *It.* pelle, pelliccia; *Sp.* piel; *P.* pelle; *G.* Pelz, Rauchwaaren; *Du.* bont; *Da.* peltsværk; *Sw.* pelsverk; *Gr.* γοῦνα; *R.* мѣхъ, myêkh.

FUSTIC (*from Lat.* fustis).—*F.* fustet; *It.* legno giallo di Brasilio; *Sp.* fustoc, fustete; *P.* jataiba; *G.* Gelbholz, Brasilienholz; *Du.* geelhout; *Da.* brasilietræ; *Sw.* gul bresilja.

GALANGAL.—*F.*, *It.*, *Sp.* galanga; *P.* galangal; *G.* Galgant; *Du.* galgel; *Da.* galange; *Sw.* galgant; *Hind.* colenjun.

GALBANUM (*Heb.*, *Arab.*, *Gr.*, *and Lat.*).—*F.* galbanum; *It.*, *Sp.*, *P.* galbano; *G.* Mutterharz; *Du.*, *Da.*, *Sw.* galbanum; *Gr.* γάλβανον; *R.* галбанъ, ghálban; *Arab.* barzud; *Pers.* beerzud; *Hind.* bireeja.

GALENA (*Gr.*).—*F.* plomb sulfuré, galène; *It.* galena; *Sp.*, *P.* galena, sulfureto di plomo; *G.* Bleiglanz; *Du.* loodzwavel; *Da.* blyglands; *Sw.* blyglans; *Gr.* μολυβδόχωμα; *R.* свинцовая руда, svinzóvaya rúda.

GALLS (*Lat.* galla).—*F.* noix de galles; *It.* galle; *Sp.* agallas; *P.* galhas; *G.* Gallapfel; *Du.* galappel; *Da.* galæble; *Sw.* galläple; *Gr.* κηκίδια; *R.* чернильный орѣхи, cherníl'nyĭ, orêkhi; *Arab.* afis; *Pers.* mazu; *Sans.* mayuphal; *Hind.* maya, majowphul; *Tam.* machakai; *Cing.* masaka.

GAMBOGE (*from* Cambodja).—*F.* gomme gutte; *Sp.* gutagamba; *F.* gutta gamba; *G.* Gummigutt, Gummi Camboja; *Du.* guttegom; *Da.* gummigut; *Sw.* gummigutta; *Gr.* κομμίδιον; *R.* гуммигутъ, gummigút; *Arab.* ossara rewund; *Hind.* ravunchenee-seerah; *Tam.* mukki; *Cing.* yokkatoo; *Siamese*, rong.

GARLIC (*Ags.* garleac, *i.e.*, spear-leek; *Lat.* allium).—*F.* ail; *It.* aglio; *Sp.* ajo; *P.* alho; *G.* Knoblauch; *Du.* knoflook; *Da.* hvidlög; *Sw.* lök; *Gr.* σκόρδον; *R.* чеснокъ, tshesnók; *Arab.* soom; *Pers.* seer; *Sans.* lasuna; *Hind.* lussun; *Tam.* vullay pundoo; *Cing.* soodooloonoo; *Mal.* bavung-pootie.

GARNET.—*F.* grenat; *It.* granato; *Sp.* granate; *P.* granada; *G.* Granat; *Du.* granaat; *Da.*, *Sw.* granat; *R.* гранатъ, ghranát.

GAS (*Ags.* gast, breath?)—*F.* gaz; *Sp.* gas; *P.* gaz; *G.*, *Du.*, *Da.*, *Sw.* gas; *R.* гасъ, gass.

GENTIAN (*Lat.* gentiana).—*F.* gentiane; *It.* genziana; *Sp.*, *P.* genciana; *G.* Enzian; *Du.* gentiaan; *Da.* enzian; *Sw.* gentian; *Gr.* γεντιανή; *R.* горчанка, ghortshánka.

GINGER (*Arabic, through Gr. and Lat.* zingiber).—*F.* gingembre; *It.* zenzevero; *Sp.* gengibre; *P.* gingivre; *G.* Ingwer; *Du.* gember; *Da.* ingefær; *Sw.* ingefära; *Gr.* ζιγγίβερις; *R.* инбирь, ínbir'; *Arab.* zingebel; *Pers.* zunjebeel; *Sans.* sunthi; *Hind.* adruck, soont; *Tam.* sukka; *Cing.* inghuru; *Mal.* alia; *Jav.* jaiaking.

GLASS (*Ags.* glæs; *Lat.* vitrum).—*F.* verre; *It.* vetro; *Sp.* vidrio; *P.* vidro; *G., Du., Da., Sw.* Glas; *Gr.* γυαλίον; *R.* стекло, stekló; *Hind., Guz.* kach.

GLUE (*Lat.* gluten).—*F.* colle forte; *It.* colla; *Sp., P.* cola; *G.* Leim; *Du.* lijm; *Da.* liim; *Sw.* lim; *Gr.* κόλλα; *R.* клеи, kléï; *Hind., Guz.* sirrus.

GOAT (*Ags.* gát; *Lat.* capra).—*F.* chèvre; *It.* capra; *Sp., P.* cabra; *G.* Ziege; *Du.* geit; *Da.* ged; *Sw.* get; *Gr.* γίδα; *R.* козелъ, kozýoll.

GOLD (*Ags. M.-Goth,* gold; *Lat.* aurum).—*F.* or; *It.* auro; *Sp.* oro; *P.* ouro; *G.* Gold; *Du.* goud; *Da., Sw.* guld; *Gr.* χρυσός; *R.* золото, zóloto; *Arab.* zeheb; *Pers.* thil; *Sans.* swarna; *Hind.* suna; *Mal.* mas.

GOOSE (*Ags.* gós; *Lat.* [g]anser).—*F.* oie; *It.* oca; *Sp.* ansar; *P.* gansi, pato; *G., Du.* Gans; *Da.* gaas; *Sw.* gås; *Gr.* χῆνα; *R.* гусь, ghus'.

GOOSEBERRY (*i.e.,* gorse, *or* prickle-berries).—*F.* groseilles; *It.* uva spina; *Sp.* grosella, espina crespa; *P.* uva espim; *G.* Stachelbeere; *Du.* kruisbes; *Da.* Stikkelsbær; *Sw.* stickelbär, krusbär; *Gr.* αγριοστάφυλον; *R.* крыжовникъ, kryzhóvnik.

GRANITE (*Lat.* granum, *grain*).—*F.* granit; *It., Sp., P.* granito; *G.* Granit; *Du.* graniet; *Da., Sw.* granit; *R.* гранитъ, ghranítt.

GRAPES (*Fr.* grappes de raisin; *Lat.* uva-æ).—*F.* raisins; *It.* uve, grappoli; *Sp.* uvas; *P.* uvas; *G.* Trauben; *Du.* druiven; *Da.* druer, viindruer; *Sw.* drufva, vindrufva; *Gr.* βότρυς; *R.* винограды, vinoghrády; *Arab.* junb; *Pers., Hind.* ungoor; *Guz.* darakh; *Mal.* booangoor.

GRASS (*Ags.* gœrs; *Lat.* herba).—*F.* herbe; *It.* erba; *Sp.* yerba; *P.* herva; *G., Du.* Gras; *Da.* græs; *Sw.* gräs; *Gr.* χόρτα; *R.* трава, travá.

GUM (*Gr.* κόμμι; *Lat.* gummi; *Ags.* goma).—*F.* gomme; *It.* gomma; *Sp.* goma; *P.* gomma; *G.* Gummi; *Du.* gom; *Da.* gummi; *Sw.* gummi; *Gr.* κόμμιον; *R.* смола, гумми, smolá, ghummi; *Hind., Guz.* goondur.

GUM ARABIC.—*Fr.* gomme arabique; *It., P.* gomma arabica; *G.* Arabische Gummi; *Du.* arabische gom; *Arab.* samagh Arabee; *Sans.* kapitha; *Hind., Guz.* Arabee goondur.

GYPSUM (*Gr. through Lat.*).—*Fr.* gypse; *It.* gesso; *Sp.* yeso; *P.*

gesso; *G.* Gips; *Du.* gips; *Da.* gibs; *Sw.* gips; *Gr.* γύψον; *R.* гипсъ, ghips.

Haddock (*Lat.* merula, *a whiting*).—*F.* merluche; *It.* merluzzo; *Sp.* merluza; *P.* pescadinha, *G.* Kabeljau, Schellfisch; *Du.* schelvisch; *Da.* kuller; *Sw.* kolja; *R.* вахня, vákhnya.

Hair (*Ags.* hær; *Lat.* capillus).—*F.* cheveu; *It.* capello; *Sp.* cabello, pelo; *P.* cabello; *G.*, *Du.*, *Da.* Haar; *Sw.* hår; *Gr.* τρίχα; *R.* волосъ, vóloss; *Hind.*, *Guz.* ball.

Hay (*Ags.* heg); *Lat.* fœnum.—*F.* foin; *It.* fieno; *Sp.* heno; *P.* feno; *G.* Heu; *Du.* hooi; *Da.* hö; *Sw.* hö; *Gr.* σανόν; *R.* сѣно, syêno; *Hind.*, *Guz.* ghans.

Hazel Nuts (*Ags.* hasel; *Lat.* avellana).—*F.* noisettes, avelines; *It.* nocciuole, aveline; *Sp.* avellanas; *P.* avellãas; *G.* Haselnusse; *Du*, hazelnooten; *Da.* hasselnöd; *Sw.* hasselnöt; *Gr.* λεπτοκάρυον; *R.* орѣхи, orêkhi; *Pers.*, *Hind.* fendook; *Beng.* bindik.

Hellebore (*Gr. through Lat.*).—*Fr.* hellébore; *It.* elleboro; *Sp.* eleboro; *P.* helleboro; *G.* Nieswurz; *Du.* nieskruid; *Da.* nyseurt; *Sw.* nys-gräs; *Gr.* ἐλλέβορος, σκάρφη; *R.* вшивый порошокъ, vshívyĭ poroshók; *Arab.* kherbek, karbek-es-wad; *Pers.* kherbek seeah; *Hind.* cudoo, kali kootkie; *Sans.* katurohina; *Tam.* kodagaroganic; *Cing.* calurana.

Hemp (*Ags.* hænep; *Lat.* cannab-is).—*F.* chanvre; *It.* canape; *Sp.* cáñamo; *P.* cánamo; *G.* Hanf; *Du.* hennep; *Da.* hamp; *Sw.* hampa; *Gr.* καννάβιον; *R.* конопель, konópel'; *Arab.* kinnub; *Hind.* sunn.

Herring-s (*Ags.* hæringc, *the fish that came in a* heer, *or* host; *comp.* viking *from* vik).—*F.* hareng-s; *It.* aringha-e; *Sp.*, *P.* arenque-s; *G.* Häring-e; *Du.* haring-en; *Da.* sild; *Sw.* sill; *Gr.* ἀρείγγα; *R.* сельди, селедки, sel'dī, selyódkī.

Hide (*Ags.* hyde; *Lat.* pellis).—*F.* peau; *It.* pelle, cuojo; *Sp.* piel, cuero; *P.* pelle, coiros; *G.* Haut, Fell; *Du.* huid, huiden; *Da.* hud; *Sw.* hud; *Gr.* δέρματα; *R.* шкуры, shkury; *Hind.* chumra; *Guz.* chamroo.

Hog, or Swine (*Welsh,* hwch; *Ags.* swín; *Lat.* porcus).—*F.* pourceau; *It.* porco; *Sp.* puerco; *P.* porco; *G.* Schwein; *Du.* varken, zwijn; *Da.* sviin; *Sw.* svin; *Gr.* γουρόυνιον, χοῖρος; *R.* свинья, svinyá.

Honey (*Ags.* hunig; *Lat.* mel).—*F.* miel; *It.* miele; *Sp.* miel; *P.* mel; *G.* Honig; *Du.* honig; *Da.* honning; *Sw.* håning; *Gr.* μέλι; *R.* медъ, meöd (compare *mead*); *Arab.* ussul-al-neh, injubeen; *Pers.* shahud; *Sans.* madhu; *Hind.* madh, shahud; *Guz.* mudh; *Tam.* tayn; *Cing.* meepanny; *Mal.* ayermadoo.

Hops (*Du.*, *unknown to Anglo-Saxons; introduced from Flanders,*

1524; *Lat.* lupulus, humulus).—*F.* houblon; *It.* lupolo; *Sp., P.* lupulo; *G.* Hopfen; *Du.* hoppen; *Da., Sw.* humle; *Gr.* χούμελη; *R.* хмѣль, khmyêl'.

HORN (*Ags.* horn; *Lat.* cornu).—*F.* corne; *It.* corno; *Sp.* cuerno; *P.* corno; *G.* Horn; *Du.* hoorn; *Da., Sw.* horn; *Gr.* κέρας κέρατον; *R.* рогъ, rogg; *Hind., Guz.* sing.

HORSE (*Ags.* hors; *Lat.* equus, caballus).—*F.* cheval; *It.* cavallo; *Sp.* caballo; *P.* cavallo; *G.* Pferd, Ross; *Du.* paard; *Da.* hest; *Sw.* häst; *Gr.* 'άλογον, 'ίππος; *R.* лошадь, loshad'.

HORSE-RADISH.—*F.* rave, raifort; *It.* rafano; *Sp.* rábano picante; *P.* rabão de cavallo; *G.* Meer-rettig; *Du.* rammenas; *Da.* peberrod; *Sw.* pepparrot; *Gr.* χρένον; *R.* хрѣнъ, khrên.

ICE (*Ags.* ís; *Lat.* glacies).—*F.* glace; *It.* ghiaccio; *Sp.* hielo; *P.* gelo, caramelo; *G.* Eis; *Du.* ijs; *Da.* iis; *Sw.* is; *Gr.* πάγος; *R.* ледъ, leódt; *Pers., Hind.* yach.

INDIA-RUBBER, or CAOUTCHOUC (*Popayan*).—*F.* gomme élastique; *It.* gomma elastica; *Sp.* goma elástica; *P.* borracha, gomma elastica; *G.* Feder-harz, Kautschuk; *Du.* verderhars, gomelastiek; *Da., Sw.* gummi; *R.* резина, rezīna.

INDIGO (*Lat.* indicum, *Indian*).—*F.* indigo; *It.* indaco; *Sp.* añil; *P.* anil (*from Arab.* an-nîl); *G., Du., Da., Sw.* Indigo; *Gr.* ἴνδικον; *R.* кубовая краска, kubováya kraska; *Arab., Pers.* neel; *Hind., Guz.* neel, goolee; *Sans.* nili; *Tam.* neelum; *Cing.* nil; *Mal.* taroom.

INK (*Du.*).—*F.* encre; *It.* inchiostro; *Sp., P.* tinta; *G.* Tinte; *Du.* inkt; *Da.* blæk; *Sw.* skrifbläck; *Gr.* μελάνη; *R.* чернило, tshernīlo; *Pers., Hind., Guz.* shai.

IRON (*Ags.* íren; *Lat.* ferrum).—*F.* fer; *It.* ferro; *Sp.* hierro; *P.* ferro; *G.* Eisen; *Du.* ijzer; *Da.* Jern; *Sw.* jern; *Gr.* σίδηρος; *R.* желѣзо, zhelêzo; *Arab.* hedeed; *Pers.* ahan; *Sans.* loha; *Hind., Guz.* looah; *Tam.* eerúmboo; *Cing.* yakada; *Mal.* bessee; *Chin.* tee.

IRONWOOD (*Botan.* Sideroxylon).—*F.* bois de fer; *It.* legno di ferro; *Sp.* palo hierro; *P.* pao de ferro; *G.* Eisenholz; *Du.* Ijzerhout; *Da.* jerntræ; *Sw.* jernträ; *Gr.* σιδηρόξυλον; *R.* твердодревникъ, tverdodrévnik.

ISINGLASS.—*F.* colle de poisson; *It.* cola di pesce; *Sp.* colapez; *P.* colla de peixe; *G.* Fischleim, Hausenblase; *Du.* huisblad, vischlijm; *Da.* huusblas; *Sw.* husblås; *Gr.* ψαρόκολλα; *R.* рыбій клей, rýbiĭ kleĭ.

IVORY (*Lat.* ebur).—*F.* ivoire; *It.* ebure; *Sp.* martil; *P.* marfim; *G.* Elfenbein; *Du.* elpenbeen, ivoor; *Da.* elfenbeen; *Sw.* elfenben; *Gr.* ελεφάντινον; *R.* слоновая кость, slónovaya kost'=elfen-

bein ; *Pers.* dundhan-i-feil ; *Hind.*, *Guz.* huthee danth (from elephant) ; moye-danth (from walrus).

Jalap (*Sp.*).—*F.* jalap ; *It.* scialappa ; *Sp.* jalapa ; *P.* jalapa ; *G.* Jalapp ; *Du.*, *Da.* jalap ; *Sw.* jalappa ; *R.* ялаппа, yalappa.

Jasper (*Gr.* ἴασπις ; *Lat.* iaspis, *from Heb.* yaspah).—*F.* jaspe ; *It.* disapro ; *Sp.* jáspe ; *P.* jaspe ; *G.* Jaspiss ; *Du.*, *Da.*, *Sw.* jaspis ; *Gr.* ἴαστιδα ; *R.* яшма, yashmá, яаеписъ, yaspīs'.

Jet (*Gr.* γαγάτης, *from* Gage, *a river of ancient Lycia*).—*F.* jais ; *It.* gagata, lustrino, pietra nera ; *Sp.* azabache ; *P.* azeviche ; *G.* Gagat, Schwarzer Bernstein ; *Du.* git ; *Da.* sort agat ; *Sw.* gagat ; *Gr.* γαγάτης ; *R.* гагатъ, gagátt.

Juniper (*Lat.* juniperus).—*F.* genièvre ; *It.* ginepro ; *Sp.* enebro ; *P.* zimbro ; *G.* Wachholder ; *Du.* Genever ; *Da.* enebær ; *Sw.* enbuske ; *Gr.* ἀρκευθος ; *R.* можжевельникъ, mozh-zhevél'nīk ; *Arab.* hoober.

Kelp.—*F.* soude ; *It.* soda ; *Sp.* sosa ; *P.* sal de soda ; *G.* Aschensalz ; *Du.* weedasch, Kelp ; *Sw.* Skottländsk soda ; *Gr.* στακτόνερον.

Kermes (*Arab.* quirmiz, *scarlet*, through *Span.*).—*F.* kermès ; *It.* chermes ; *Sp.* quérmes ; *P.* kermes ; *Ger.* Kermes, Scharlachbeere ; *Du.* scharlakenbezie ; *Da.* skarlagens bær ; *Sw.* kermesbär ; *Gr.* κρεμέζιον, πρινοκόκκιον ; *R.* червецъ, tchervéts, листососъ, līstosóss ; *Hind.*, *Guz.* kirmiz, kermes.

Kino.—*F.* gomme de kino ; *It.* chino ; *Sp.* quino ; *G.* Kino-harz ; *Beng.* palass-goond.

Lac (*Sans.*, *Pers.*).—*F.* laque ; *It.* lacca ; *Sp.*, *P.* laca ; *G.* Lack ; *Da.* lak ; *Sw.* lack ; *Gr.* βερνίκιον ; *R.* (гумми) лакъ, (ghummi) láck ; *Arab.*, *Pers.* laak ; *Sans.* laksha ; *Hind.*, *Guz.* lakh ; *Tam.* komburruk ; *Cing.* lakada ; *Mal.* ambaloo ; *Jav.* balo.

Lavender (*Lat.* lavandula).—*F.* lavande ; *It.* spigo, lavendola ; *Sp.* espliego, lavandula ; *P.* alfazema ; *G.*, *Du.*, *Da.*, *Sw.* Lavendel ; *Gr.* νάρδος ; *R.* увѣчная трава, uvyêtshnaya travá.

Lead (*Ags.* lead ; *Lat.* plumbum).—*F.* plomb ; *It.* piombo ; *Sp.* plomo ; *P.* chumbo ; *G.* Blei ; *Du.* lood ; *Da.* bly ; *Sw.* bly ; *Gr.* μολύβιον ; *R.* свинецъ, svinéts ; *Arab.* anuk ; *Pers.* surb ; *Sans.* sisaka ; *Hind.*, *Guz.* seesa ; *Tam.* eeum ; *Mal.* temaltam ; *Chin.* hih yèn.

Leather (*Ags.* ledher ; *Lat.* corium).—*F.* cuir ; *It.* cuojo ; *Sp.* cuero ; *P.* coiro ; *G.*, *Du.* Leder ; *Da.* læder ; *Sw.* läder ; *Gr.* πετζίον ; *R.* кожа, kozha ; *Pers.* churm ; *Hind.* chumra ; *Guz.* chamroo.

Leech (*Ags.* læce, *a physician, surgeon*).—*F.* sangsue ; *It.* sanguisuga ; *Sp.* sanguijuela ; *P.* sanguisuga ; *G.* Blutigel ; *Du.* bloedzuiger ; *Da.*, *Sw.* blodigel ; *Gr.* ἀβδέλλα ; *R.* піявица, piyávitsa ; *Arab.* aluk, kheeraheen ; *Pers.* zeloo ; *Sans.* jaluka ; *Hind.* jook ; *Tam.* attei ; *Cing.* koodalla ; *Mal.* patchet.

LEMON (*Gr. through Lat.*).—*F.* limon; *It.* limone; *Sp.* limon; *P.* limão; *G.* Limone; *Du.* limoen; *Da.*, lemon; *Sw.* limon; *Gr.* λειμόνιον; *R.* лимонъ, līmón; *Arab.* lemoon; *Pers.* leembo; *Hind.*, *Guz.* limboo, neemboo.

LETTUCE (*Lat.* lactuca, *from* lac, *milky juice*).—*F.* laitue; *It.* lattuga; *Sp.* lechuga; *P.* alface; *G.* Lattich; *Du.* latuw; *Da.* salat, laktuk; *Sw.* laktuk; *R.* латукъ, latúk; *Hind.*, *Guz.* kahoo.

LIME (*Ags.* lím, *glue, cement, mortar, whence limestone—the cementing stone; Lat.* calx).—*F.* chaux; *It.* calcina; *Sp.*, *P.* cal; *G.* Kalk, Leim; *Du.*, *Da.*, *Sw.* kalk; *Gr.* ἄσβεστος, κόλλα; *R.* невесть, ísvest'; *Arab.* ahuk; *Pers.* nureh; *Sans.* churna; *Hind.* chuna; *Tam.* chunamboo; *Cing.* hunnoo; *Mal.* capoor.

LINDEN (*Ags.* linde; *Lat.* tilia).—*F.* tilleul; *It.* tiglio; *Sp.* tilo, teja; *P.* til, tilia; *G.* Linde; *Du.* linde-boom; *Da.* linde-træ; *Sw.* lind; *Gr.* φίλυρα; *R.* липа, līpa.

LINSEED.—*F.* graine de lin; *It.* semenza di lino; *Sp.* linaza; *P.* linhaça; *G.* Leinsamen; *Du.* lijnzaad; *Da.* hörfrö; *Sw.* linfrö; *Gr.* λιναρόσπορος; *R.* льняное сѣмя, l'nánoe syêma; *Arab.* buzruk; *Pers.* tukhem-i-kitan; *Sans.* uma, atisi; *Hind.* suf, tisi, ulsee; *Tam.* alleverei, sirru sannulverei; *Mal.* bidgierammee.

LIQUORICE (*corrupted from Gr.* glycyrhiza, *sweet-root*).—*F.* réglisse; *It.* regolizia, logorizia; *Sp.* regaliza; *P.* regoliz, alcaçuz; *G.* Süssholz, Lakritze; *Du.* zoethout; *Da.* lakris; *Sw.* lakrits; *Gr.* γλυκόρριζα; *R.* солодковый корень, solodkovyĭ kóren'; *Arab.* uss-ul-soos; *Pers.* bikhmekeh; *Sans.* madhuka, yusti-madhuka; *Hind.*, *Guz.* jettimud; *Tam.* addimodrum; *Cing.* wellmie, olinde; *Mal.* urat-manis; *Jav.* oyotmanis.

LITHARGE (*Gr. through Lat.* Lithargyrium, *silver-stone*).—*F.* litharge; *It.* litargirio; *Sp.* almartaga; *G.* Glötte, Glätte; *Du.* gelit; *Da.* sölvskum, blyskum; *Sw.* glitt; *Gr.* λιθάργυρος; *R.* глетъ, glett; *Pers.* murdarsang; *Hind.* murdarsang, boodar; *Tam.* marudarsinghie.

LITMUS.—*F.* tournesol; *It.* tornasole; *Sp.* tornasól en pasta; *G.* Lackmuss; *Du.* lakmoes; *Da.* lakmus; *Sw.* lackmus.

LOBSTER (*Ags.* loppestre; *Lat.* gammarus, cammarus, astacus, locusta).—*F.* homard; *It.* gambero di mare; *Sp.* langosta; *P.* lagosta; *G.* Hummer; *Du.* zeekreeft; *Da.*, *Sw.* hummer; *Gr.* ἀστακός; *R.* морской ракъ, morskóy rakk.

LOGWOOD.—*F.* bois de Campêche; *It.* legno Campeggio; *Sp.* palo de Campéche; *P.* pão de Campeche; *G.* Campesche-holz, Blau-holz; *Du.* kampechehout; *Da.* Campechetræ; *Sw.* kampecheträd; *R.* кампешское дерево, kampésh-skoë dérevo.

MACE (*Gr.* μάκερ; *Lat.* macis).—*F.*, *It.*, *Sp.*, *P.* macis; *G.* Muskaten-

blüthe; *Du.* foelij; *Da.* muskatblomme; *Sw.* muskotblomma; *Gr.* μοσχοκάρυδον; *R.* мушкатный цвѣтъ, mushkatnyĭ tsvyêt; *Arab.* talzuffar; *Pers.* bez-baz; *Sans.* jatipatri; *Hind,* jaiputree, jaiwantry; *Tam.* jadiputrie; *Cing.* wassawassie; *Mal.* bunga-bua-pala; *Jav.* kambang-pala; *Bali,* bunga-pala.

MACKEREL (*Du.*).—*F.* maquereau; *It.* sgombro; *Sp.* escombro; *P.* cavalla; *G.* Makrele; *Du.* makreel; *Da.* makrel; *Sw.* makrill; *Gr.* σγόμβρος; *R.* макрель, makrél'.

MADDER (*Ags.* mæddere; *Lat.* rubia).—*F.* garance; *It.* robbia; *Sp.* rubia; *P.* ruiva; *G.* Krapp; *Du.* meekrap; *Da.* krap; *Sw.* krapp; *Gr.* ἐρυθρόδανον, ῥιζάριον; *R.* марена, крапъ, maryóna, krapp; *Arab.* fuh; *Pers.* ru-nas; *Sans.* manjishtha; *Hind.* munjeet; *Tam.* manjittie; *Cing.* well-mudutta.

MAGNESIA.—*F.* magnésie; *It.*, *Sp.*, *P.* magnesia; *G.* Magnesia, Bittererde; *Du.*, *Da.*, *Sw.* magnesia; *Sw.* talkjord.

MAGNET, or LOADSTONE (*Gr.* μάγνης, *from Magnesia in ancient Lydia*; *Lat.* magnes).—*F.* aimant; *It.* magnete, calamita; *Sp.* imán; *P.* iman; *G.* Magnet; *Du.* magneet, zeilsteen; *Da.*, *Sw.* magnet; *Gr.* μαγνήτης; *R.* магнитъ, magnít; *Pers.* ahan-subah; *Hind.*, *Guz.* chumuk puttur; *Tam.* kaundum.

MAHOGANY (*Carribbean*).—*F.* acajou; *It.* maogani; *Sp.* caóba, caobána; *P.* pão magno; *G.* Mahagony; *Du.* mahoniehout; *Da.* mahonitræ; *Sw.* mahogony; *R.* красное дерево, krasnoë dérevo.

MAIZE (*Gr.* μάζα, *through Lat.*).—*F.* maïs; *It.* saggina, grano Turco; *Sp.*, *P.* maiz; *G.* Mais, Türkischer Weizen; *Du.* Turksche tarwe; *Da.* mais, tyrkisk hvede; *Sw.* mais, Turkisk hvete; *Gr.* ἀραποσίτιον; *R.* маисъ, кукуруза, má-iss, kukurúza; *Hind.*, *Guz.* boota; *Beng.* mokka.

MALLOW (*Lat.* malva).—*F.* mauve; *It.*, *Sp.*, *P.* malva; *G.* Malve, Pappel; *Du.* maluwe; *Da.* katost; *Sw.* kattost; *Gr.* μολόχη; *R.* просвирки, prosvírkī.

MANGANESE (*Gr.* μαγγανεία, *sorcery, poisoning*).—*F.* manganèse; *It.*, *P.* manganese; *Sp.* manganesa; *G.* Braunstein, Mangan; *Du.* bruinsteen; *Da.* brunsteen; *Sw.* manganes, brunsten.

MANGO.—*F.* mangou; *It.*, *Sp.* mango; *P.* mangue; *G.* Mango; *Du.*, *Da.*, *Sw.* mango; *Hind.* amb; *Guz.* caree.

MAPLE (*Ags.* mapul; *Lat.* acer).—*F.* érable; *It.* acero; *Sp.* arce; *P.* bordo; *G.*, *Du.* Ahorn; *Da.* valbirk; *Sw.* lönn; *Gr.* σφένδαμνος; *R.* кленъ, klyón.

MARBLE (*Gr.* μαρμαίρω, to glitter, *hence Gr.* μάρμαρος; *Lat.* marmor, *the shining stone*).—*F.* marbre; *It.* marmo; *Sp.* mármol; *P.* marmore; *G.* Marmor; *Du.* marmer; *Da.*, *Sw.* marmor; *Gr.* μάρμαρον; *R.* мраморъ, mrámor; *Pers.*, *Hind.* murmur.

MARL (*name common to Welsh and Teutonic*).—*F.* marne; *It.* terra grassa; *Sp.*, *P.* marga; *G.* Märgel; *Du.*, *Da.*, *Sw.* mergel; *R.* мергель, mergel', рухлякъ, rukhlyák.

MASTIC (*Gr. through Lat.*). *F.* mastic; *It.* mastico, mastrice; *Sp.* almaciga, almastiga; *P.* mastique, almecega; *G.* Mastix; *Du.* mastic (gom); *Da.*, *Sw.* mastix; *Gr.* μαστίχη; *R.* мастикъ, mástik; *Turk.* sakes; *Arab.* arah, auluh Bagdadie; *Pers.* kinneh; *Hind.*, *Tam.* roomie, mustakie.

MEDLAR (*Ags.* mæd; *Lat.* mespilum, *from Gr.* μέσπιλον).—*F.* nèfle; *It.* nespola; *Sp.* nispero; *P.* nespera; *G.*, *Du.*, *Da.*, *Sw.* Mispel; *Gr.* μέσπιλον, νέσπουρον; *R.* кизиль, kízīl'.

MERCURY (*Lat.* Mercurius).—*F.* mercure; *It.* mercurio, argento vivo; *Sp.*, *P.* mercurio; *P.* azougue; *G.* Quecksilber, Mercur; *Du.* kwikzilver; *Da.* qvægsölv; *Sw.* qvicksilfwer; *Gr.* ὑδράργυρος, διάργυρος; *R.* ртуть, rtut'; *Arab.* abuk, zibakh; *Pers.* seemáb; *Sans.* rasa, sutum, parada; *Hind.* parah; *Tam.* rasam; *Mal.* rassa; *Chin.* shwuy-yin.

MICA (*Lat.* mico, *to sparkle.*)—*F.*, *It.*, *Sp.*, *P.* mica; *G.* Glimmererde; *Du.* glimmer, mica; *Da.*, *Sw.* glimmer.

MILK (*Ags.* meo-loc; *Lat.* [g]lac; *Gr.* ga-lak).—*F.* lait; *It.* latte; *Sp.* leche; *P.* leite; *G.* Milch; *Du.*, *Da.* melk; *Sw.* mjölk; *Gr.* γάλα; *R.* молоко, molokó; *Arab.* laba; *Pers.* sheer; *Hind.* dood; *Sans.* gokshira; *Tam.* pashuin paal; *Cing.* ellakerrie; *Mal.* soosoo.

MILLET (*Lat.* milium).—*F.* mil; *It.* miglio; *Sp.* mijo; *P.* milho miudo; *G.* Hirse; *Du.* gierst; *Da.* hirse; *Sw.* hirs; *Gr.* κέγχριον; *R.* просо, prosso, пшено, pshenó; *Arab.* dukhn; *Pers.* arzun; *Sans.* kangu, priyangu; *Hind.* kang; *Beng.* kungoo; *Tam.* tenny; *Cing.* tana-hal; *Mal.* navaria.

MOHAIR.—*F.* moire; *It.* cambellotto, panno di peli di camello; *Sp.* camelote; *P.* chamalote, melania; *G.* Mohr, Haartuch; *Du.* kemelshaar; *Da.* kameelgarn; *Sw.* kamlott; *Gr.* σόφιον τριχίνιον; *R.* обьяръ, obyárr, моръ, morr.

MOTHER-OF-PEARL.—*F.* nacre de perle; *It.*, *Sp.* madreperla; *P.* madreperola; *G.* Perlenmutter; *Du.* parelmoer; *Da.* perlemoor; *Sw.* perlemor; *R.* перломутръ, perlomútr; *Pers.*, *Hind.* cheep.

MULE (*Lat.* mulus).—*F.* mulet; *It.*, *Sp.* mulo; *P.* macho, mula; *G.* Maulthier; *Du.* muilezel; *Da.* muulæsel; *Sw.* mulåsna; *Gr.* μουλάριον; *R.* лошакъ, мулъ, lóshak, mul.

MUSHROOM (*corruption of French*).—*F.* mousseron, champignon; *It.* fungo; *Sp.* seta; *P.* fungo, cogumelo; *G.* Erdschwamm; *Du.* paddestoel; *Da.* champignon, jordsvamp; *Sw.* svamp, champinjon; *Gr.* μανιτάριον; *R.* грибъ, ghrīb.

MUSK (*Gr.* μόσχος, *through Lat.*).—*F.* musc ; *It.* muschio ; *Sp.* musco, almizcle; *P.* almiscar ; *G.* Moschus, Bisam ; *Du.* muskus ; *Da.* muscus, desmer ; *Sw.* muskus, desman ; *Gr.* μόσχος ; *R.* мускусъ, múskus ; *Arab.*, *Pers.* miskh, muskh ; *Sans.* mooshka, kasturie ; *Hind.* kustooree ; *Tam.* custoori ; *Cing.* rutta ooroola ; *Mal.* jebat ; *Jav.* dedes.

MUSSEL (*Ags.* muscle, muxcle).—*F.* moule ; *It.* nicchio ; *Sp.* almeja ; *P.* mexilhão ; *G.* Muschel ; *Du.* mossel ; *Da.* musling ; *Sw.* mussla ; *Gr.* κόγχλη ; *R.* ракушка, rakúshka.

MUSTARD (*Gr. and Lat.* sinapi ; *Arab. through Sp. and Fr.*).—*F.* moutarde ; *It.* senape ; *Sp.* mostaza ; *P.* mostarda ; *G.* Senf ; *Du.* mosterd ; *Da.* senep ; *Sw.* senap ; *Gr.* σινάπιον ; *R.* горчица, ghortshītsa ; *Arab.* khirdal ; *Pers.* sirshuff ; *Sans.* sirsūn, rajika ; *Hind.* kalee rai ; *Tam.* kadaghoo ; *Cing.* gan-aba ; *Mal.* sasavie.

MYRRH (*Gr. through Lat.* myrrha).—*F.* myrrhe ; *It.*, *Sp.* mirra ; *P.* mirra, myrrha ; *G.* Myrrhe ; *Du.* mirre ; *Da.*, *Sw.* myrrha ; *Gr.* μυῤῥα ; *R.* мирра, mīrra, смирна, smīrna ; *Arab.* murr ; *Hind.* herabole ; *Sans.* vola ; *Tam.* valatipolum, villey bolum, palendra-bolum ; *Mal.* manisan-lebah ; *Jav.* madu.

NAPHTHA (*Gr.*).—*F.* naphte ; *It.*, *Sp.* nafta ; *P.* naphtha ; *G.* Steinöl ; *Du.* naftha ; *Da.* naphta ; *Sw.* nafta ; *Gr.* νάφθα, πετρέλαιον ; *Arab.* neft ; *Sans.* bhumi tailum ; *Hind.* nukteil, mittie-ka-teil ; *Tam.* mun tylum ; *Mal.* minnia tanna.

NICKEL (*Ger.*).—*F.* nickel ; *Sp.*, *P.* niquel ; *G.* Nickel ; *Du.* nikkel ; *Da.*, *Sw.* nickel.

NITRE, SALTPETRE (*Gr.*, *Lat.*).—*F.* nitre ; *It.* nitro, salnitro ; *Sp.*, *P.* nitro ; *P.* salitre ; *G.*, *Du.*, *Da.* Salpeter ; *Sw.* saltpeter ; *Gr.* νίτρον ; *R.* селитра, selítra ; *Arab.* ubkir ; *Pers.* shora ; *Sans.* yavakshra ; *Hind.* sooriakhar ; *Tam.* potti-loopoo ; *Cing.* wedie-loonoo ; *Mal.* sandawa, mesiumentah.

NUT (*Ags.* hnut ; *Lat.* nux).—*F.* noix ; *It.* noce ; *Sp.* nuez ; *P.* noz ; *G.* Nuss ; *Du.* noot ; *Da.* nöd ; *Sw.* nöt ; *Gr.* καρύδιον ; *R.* орѣхъ, oryêkh.

NUTMEG (Nut-mace?).—*F.* noix de muscade ; *It.*, *Sp.*, *P.* moscada ; *G.* Muskaten-nuss ; *Du.* nootmuskaat ; *Da.* muskatnöd ; *Sw.* muskot ; *Gr.* μοσχοκάρυδον ; *R.* мушкатный орѣхъ, mushkátnyĭ oryékh ; *Arab.* jowz-al-teib ; *Pers.* jowz bewa ; *Sans.* jatiphala ; *Beng.* jaya-phala ; *Hind.* jaiphul ; *Tam.* jadikai ; *Cing.* jatipullum, sadikka ; *Mal.* buah-pala ; *Jav.* woh-pala ; *Bali.* bu-wah-pa.

OAK (*Ags.* ác ; *Lat.* quercus, robur).—*F.* chêne ; *It.* quercia ; *Sp.* roble ; *P.* carvalho ; *G.* Eiche ; *Du.* eik ; *Da.* eeg ; *Sw.* ek ; *Gr.* δρύς, βαλανιά ; *R.* дубъ, dubb ; *Arab.* baalut.

OATS (*Ags.* áta ; *Lat.* avena).—*F.* avoine ; *It.* vena ; *Sp.* avena ; *P.*

avêa; *G.* Hafer; *Du.* haver; *Da.* havre; *Sw.* hafre; *Gr.* βρόμιον; *R.* овесъ, ovyóss.

Ochre (*Gr.* ochra).—*F.* ocre; *It.* ocra; *Sp.*, *P.* ocre; *G.* Ocher, Ocker; *Du.* oker; *Da.* okker; *Sw.* ockra; *Gr.* ὤχρα; *R.* охра, okhra; *Hind.*, *Guz.* pewdee (yellow), sonagaroo (red).

Oil (*Ags.* ele, *from Gr.* ἔλαιον; *Lat.* oleum).—*F.* huile; *It.* olio; *Sp.* aceite; *P.* azeite, oleo; *G.* Oel; *Du.*, *Da.* olie; *Sw.* olja; *Gr.* λάδιον, ἔλαιον; *R.* масло, masslo; *Pers.* roghun; *Hind.* teil.

Olibanum (*Arab.*, *Gr.*).—*F.* olibanum; *It.*, *Sp.*, *P.* olibano; *G.*, *Du.*, *Da.*, *Sw.* Olibanum; *Gr.* ὀλίβανον; *R.* олибанъ, oliban; *Arab.*, *Pers.* luban · *Hind.* koondur zuchir; *Beng.* gunda barosa; *Tam.* paranghi sambrani.

Olive (*Lat.* oliva).—*F.* olive; *It.* uliva; *Sp.* oliva, aceituna; *P.* azeitona; *G.* Olive, Oelbeere; *Du.* olijf; *Da.*, *Sw.* oliv; *Gr.* ἐλαία; *R.* масличина, олива, maslītshīna, olīva; *Arab.*, *Pers.*, *Hind.* zeitoon.

Onion (*Lat.* cepa).—*F.* oignon; *It.* cipolla; *Sp.* cebolla; *P.* cebola; *G.* Zwiebel; *Du.* uije, ajuin; *Da.* lög; *Sw.* lök; *Gr.* κρομμύδιον; *R.* лукъ, luk; *Arab.* bussel; *Pers.* peeaz; *Sans.* palandu, latarka, sukundaka; *Hind.* peeaz; *Guz.* khanda, peeaz; *Tam.* venggayum; *Cing.* loono; *Mal.* bavangmira; *Jav.* brang-bang.

Onyx (*Gr.* ὄνυξ).—*F.* onyx; *It.* onice; *Sp.* onique, oniz; *P.* onyx; *G.* Onyx, Onychstein; *Du.*, *Da.* onyx; *Sw.* onix; *R.*ониксъ, oniks.

Opal (*Lat.* opalus).—*F.* opale; *It.*, *Sp.* opalo; *P.* opala; *G.* Opal; *Du.* opaal; *Da.*, *Sw.* opal; *R.* опалъ, opáll.

Opium (*Lat.*).—*F.* opium; *It.* oppio; *Sp.*, *P.* opio; *G.* Opium, Mohnsaft; *Du.* opium; *Da.* opium, valmuesaft; *Sw.* opium, vallmosaft; *Gr.* ὄπιον, ’αφιώνιον; *R.* маковый сокъ, опiумъ, mákovyĭ sok, opium; *Turk.* majoon; *Arab.* ufyoon; *Pers.* ufyoon, sheer-i-kush-khush; *Sans.* chasa, apaynum; *Hind.* ufyoon, ufeem; *Tam.* apini; *Cing.* abim; *Mal.* ufyoon, caruppa; *Jav.* apium; *Bali*, hapium.

Orange (*Lat.* aurantium).—*F.* orange; *It.* arancia; *Sp.* naranja; *P.* laranja; *G.* Apfelsine, Orange; *Du.* oranje; *Da.* apelsin, pomerands; *Sw.* apelsin, orange, pomerans; *Gr.* νεράντζιον; *R.* оранiя, померанецъ, orániya, pomeránets; *Pers.* narungee; *Sans.* naga-runga; *Hind.* narunghie; *Tam.* kichlie-pullum, collungie pullum; *Cing.* panneh dodang; *Mal.* simao manis.

Orchill, Archil.—*F.* orseille; *It.* orcella, oricello; *Sp.* orchilla; *P.* orsella; *G.* Orseille; *Du.* purpermos; *Sw.* orselj, orsilja.

Orpiment, Yellow, Sulphuret of Arsenic (*Lat.* auri pigmentum, *golden pigment*).—*F.* orpiment; *It.* orpimento; *Sp.* oropimente;

*P.* ouropimente; *G.* Orpement, Rauschgelb; *Du.* opremen t; *Da.*, *Sw.* auripigment (arsenik blandet med svovl); *R.* оперментъ, operment, желтый мышьякъ, zholtyĭ myshyáck; *Arab.* ursanikoon; *Pers.* zerneik-zurd; *Sans.* haritalaka; *Hind.* hurtal; *Tam.* aridurum, yelliekood-pashanum.

OSTRICH (*Lat.* avis struthio).—*F.* autruche; *It.* struzzo; *Sp.* avestruz; *P.* abestruz; *G.* Strauss; *Du.* struisvogel; *Da.* strudsfugl; *Sw.* struts; *Gr.* στρουθοκάμηλος; *R.* строусъ, stroüss.

OYSTER (*Gr. through Lat.*).—*F.* huître; *It.* ostrica; *Sp.*, *P.* ostra; *G.* Auster; *Du.* oester; *Da.* østers; *Sw.* ostron, ostra; *Gr.* ὀστρίδιον; *R.* устрица, ústrītsa; *Hind.*, *Guz.* kaloo.

PALM (*Lat.* palma).—*F.* palmier; *It.*, *Sp.*, *P.* palma; *G.* Palme; *Du.* palm; *Da.* palme (træ); *Sw.* palm; *Gr.* φοινικιά; *R.* пальма, palma.

PARSNIP (*corruption of* pastnik, *from Lat.* pastinaca).—*F.* panais; *It.* pastinaca; *Sp.* chirivía; *P.* cenoura branca; *G.* Pastinake; *Du.*, *Da.* pastinak; *Sw.* palsternacka; *Gr.* καβούτζιον; *R.* пастернакъ, pasternák.

PEAR (*Ags.* peru; *Lat.* pyrum).—*F.* poire; *It.*, *Sp.*, *P.* pera; *G.* Birne; *Du.* peer; *Da.* pære; *Sw.* päron; *Gr.* ἀπίδιον; *R.* груша, ghrusha.

PEARL (*Ags.* pærl).—*F.* perle; *It.*, *Sp.* perla; *P.* perola; *G.* Perle; *Du.* parel; *Da.* perle; *Sw.* perla; *Gr.* μαργιτάριον; *R.* жемчужина, zhemtshúzhina, перла, perla; *Arab.* lulu; *Pers.* murwareed; *Hind.* moothee; *Tam.* motu; *Cing.* mutu.

PEASE (*Ags.* pise; *Lat.* pisum).—*F.* pois; *It.* piselli; *Sp.* guisantes; *P.* ervilhas; *G.* Erbsen; *Du.* erwten; *Da.* ærter; *Sw.* ärter; *Gr.* ἀρακᾶς, πίζα; *R.* горохъ, ghorókh; *Pers.* kirseneh; *Sans.* harenso; *Hind.* wuttana; *Tam.* puttanie.

PEAT.—*F.* tourbe; *It.*, *Sp.* turba; *P.* terra combustivel; *G.* Torf, Braunkohle; *Du.* turf; *Da.* törv; *Sw.* torf; *Gr.* μαυρολάχανον; *R.* торфъ, torph.

PEPPER, BLACK (*Ags.* pipor, *from Lat.* piper).—*F.* poivre; *It.* pepe nero; *Sp.* pimienta; *P.* pimenta; *G.* Pfeffer; *Du.* peper; *Da.* peber; *Sw.* peppar; *Gr.* πιπέρι; *R.* перецъ, pérets; *Arab.* fiffil uswood; *Pers.* fiffil-i-seeah; *Sans.* maricha; *Hind.* kala-mirree, gool-mirch; *Tam.* mellaghoo; *Cing.* gammiris; *Mal.* lada; *Jav.* maricha; *Bali*, micha; *Palembang*, sahan.

PEPPER, CAYENNE. See CAPSICUM.

PEPPER, JAMAICA. See PIMENTO.

PEPPER, LONG.—*F.* poivre long; *It.* pepe lungo; *Sp.* pimenta larga; *P.* pimenta longa; *Ger.* Lange Pfeffer; *Du.* lange peper, staart-peper; *Arab.* dar-fiffil; *Pers.* fiffill-i-daraz; *Sans.* pippali krishna; *Hind.* pepeelee; *Tam.* tipili; *Cing.* tipili; *Mal.* tabee.

PHOSPHORUS (*Gr.* light bearing). — *F.* phosphore ; *It.*, *Sp.* fosforo ; *P.* phosphoro ; *G.* Phosphor ; *Du.* phosphorus ; *Da.* phosphor ; *Sw.* fosfor ; *Gr.* *φώσφορος* ; *R.* **фосфоръ**, phosphor, **свѣтоносъ**, svyêtonoss.

PILCHARD, SARDINE. — *F.* sardine ; *It.* saracca ; *Sp.* sardina ; *P.* sardinha ; *G.* Pilscher, Sardelle ; *Du.* sardijn ; *Da.* sardine, sardelle ; *Sw.* sardin, sardell ; *Gr.* *σάρδα*, *σαρδέλλα* ; *R.* **сардель**, **салакушка**, sardyoll, salakushka.

PIMENTO, ALLSPICE, JAMAICA PEPPER. — *F.* piment, poivre de Jamaïque ; *It.* pimenta, pepe garofanato ; *Sp.* pimienta de la Jamaica ; *P.* pimenta du Jamaica ; *G.* Piment, Jamaica Pfeffer, Nelken Pfeffer ; *Du.*, *Da.* piment ; *Sw.* kryddpeppar ; *R.* **Англійскій перецъ**, ángliĭskiĭ pérets.

PINE (*Lat.* pinus).—*F.* pin ; *It.*, *Sp.* pino ; *P.* pinheiro ; *G.* Fichte ; *Du.* pijn ; *Da.*, *Sw.* gran ; *Gr.* *πεύκη* ; *R.* **сосна**, sosna.

PINE APPLE (*Peruv.* nanas—*first seen by Europeans in Peru in the sixteenth century*).—*F.* ananas ; *It.* annanasso ; *Sp.* anana ; *P.* ananás ; *G.* Ananas ; *Du.* pijnappel ; *Da.*, *Sw.* ananas ; *Gr.* *ἀνανάς* ; *R.* **ананасъ**, ananáss ; *Hind.* annanas ; *Tam.* anasiepullum ; *Cing.* anasi ; *Mal.* nanas-naneh.

PISTACHIO (*Pers.* pistak, *through Gr.*, *Lat.*, *and It.*).—*F.* pistache ; *It.* pistacchio ; *Sp.* pistacho, alfoncigos ; *P.* fistica, pistacha ; *G.* Pistazie ; *Du.* pistachenoot ; *Da.* pistasie ; *Sw.* pistacie ; *Gr.* *πιστάκιον* ; *R.* **фисташка**, fistáshka ; *Hind.* pistach.

PITCH (*Ags.* pic ; *Lat.* pix).—*F.* poix ; *It.* pece ; *Sp.*, *P.* pez ; *G.* Pech ; *Du.* pek, pik ; *Da.* beg ; *Sw.* beck ; *Gr.* *πίσσα* ; *R.* **смола**, smola ; *Hind.* pitch.

PLANTAIN.—*F.* plantain ; *Sp.* platano ; *P.* plantano ; *G.* Pisang, Paradiesfeige ; *Du.* pisang ; *Da.*, *Sw.* pisang ; *R.* **попутникъ**, popútnik ; *Sans.* kudali ; *Hind.* kayla ; *Tam.* valiepullum ; *Cing.* kehlkang ; *Mal.* pesang.

PLATINA (*Sp.* plata, *silver*).—*F.* platine ; *It.*, *Sp.*, *P.* platina ; *G.* Platin ; *Du.*, *Da.*, *Sw.* platina ; *R.* **платина**, platīna

PLUM (*Ags.* plume ; *Lat.* prunum).—*F.* prune ; *It.* prugna, susina ; *Sp.* ciruela ; *P.* ameixa ; *G.* Pflaume ; *Du.* pruim ; *Da.* blomme, svedske ; *Sw.* plommon ; *Gr.* *δαμάσκηνον* ; *R.* **слива**, slīva.

PLUMBAGO, BLACK LEAD (*Lat.*).—*F.* plombagine, potelot ; *It.* piombaggine, tocca lapis ; *Sp.* lapiz plomo, carbureto de hierro ; *P.* lapis ; *G.* Reissblei, Pottloth ; *Du.* potlood ; *Da.* blyant ; *Sw.* Engelsk blyerts ; *R.* **черный карандашъ**, tshernyĭ karandásh.

POMEGRANATE (*Lat.* pomum granatum, *an apple of grains*). — *F.* grenade ; *It.* mela grana ; *Sp.* granada ; *P.* romãa, roman ; *G.* Granatapfel ; *Du.* granaatappel ; *Da.* granatæble ; *Sw.* granatäple ;

*Gr.* ροΐδιον; *R.* гранатъ, granát; *Turk.* nar; *Arab.* rana, rooman; *Pers.* anaar; *Sans.* dadima; *Hind.* anaar, darim; *Tam.* magilum palam; *Cing.* delunghidie; *Mal.* dalema.

POPLAR (*Lat.* populus).—*F.* peuplier; *It.* pioppo; *Sp.* alamo; *P.* choupo, álemo; *G.* Pappel; *Du.* populier; *Da.* poppeltræ; *Sw.* poppelträd; *Gr.* λέυκη ἄιγειρος; *R.* осина, osīna.

POTASH.—*F.* potasse; *It.* potassa; *Sp.* potasa; *P.* potassa; *G.* Pottasche; *Du.* potasch; *Da.* potaske; *Sw.* pottaska; *R.* сѣрый поташъ, syêryĭ potásh; *Hind.* jowkshar; *Tam.* maraoopoo.

POTATO (*from S. American* batata, *the sweet potato, known in Europe before the plant now called potato, which was confounded with it at first erroneously*).—*F.* patate, pomme de terre; *It.* patata; *Sp.* patata; *P.* batata; *G.* Kartoffel; *Du.* aardappel; *Da.* kartoffel; *Sw.* potates, jordpäron; *Gr.* γαιόμηλον; *R.* картофель, kartófel'; *Pers.* aloo; *Hind.* aloo, puttata; *Tam.* wallarai kilangoo; *Cing.* ruta innala.

POULTRY (*Fr.*).—*F.* volaille; *It.* pollame; *Sp.* aves de corrál; *P.* aves domesticas; *G.* Geflügel; *Du.* gevogelte; *Da.* höns, fiederkræ; *Sw.* fjäderfä; *Gr.* πουλερά; *R.* куры, kury.

PUMICE (*Lat.* pumex).—*F.* pierre ponce; *It.* pomice; *Sp.* piedra pómez; *P.* pedra pomes; *G.* Bimstein; *Du.* puimsteen; *Da.* pimpsteen; *Sw.* pimpsten; *Gr.* κίσσηρις; *R.* пемза, pemza.

QUINCE (*Fr.* coings).—*F.* coing; *It.* mela cotogna; *Sp.* membrillo; *P.* marmelo; *G.* Quitte; *Du.* kwepeer; *Da.* qvæde; *Sw.* qvitten; *Gr.* κυδώνιον; *R.* айва, aĭvá; *Arab.*, *Pers.*, *Hind.*, *Tam.* behdana.

RAISINS (*Fr.* grapes).—*F.* raisins secs; *It.* uve passe; *Sp.* pasas, uvas secas; *P.* passas de uva; *G.* Rosinen; *Du.* rozijnen; *Da.* Rosiner; *Sw.* russin; *Gr.* σταφίδαι; *R.* изюмины, īzyúmīny; *Hind.* darakh, mowage.

RAPE (*Lat.* rapa).—*F.* râpe; *It.* rapa; *Sp.* nabina; *P.* nabiça; *G.* Rübsen, Rübsamen; *Du.* raap; *Da.* raps; *Sw.* rapsat; *R.* кольраби, kolrábī; *Hind.* sursee, surrus.

RASPBERRY.—*F.* framboise; *It.* mora di rovo; *Sp.* frambuesa; *P.* frambesia; *G.* Himbeere; *Du.* flamboos; *Da.* hindbær; *Sw.* hallon; *Gr.* σμέουρον; *R.* малина, malīna.

RESIN (*Lat.* rèsina).—*F.* résine; *It.* ragia, resina; *Sp.*, *P.* resina; *G.* Harz; *Du.* hars; *Da.* harpix; *Sw.* harts, kåda; *Gr.* ρετζίνη, ἀραζίνη; *R.* камедь, kaméd'.

RHUBARB (*Lat.* rha, *and* barba).—*F.* rhubarbe; *It.* reubarbaro; *Sp.* ruibarbo; *P.* rhuibarbo; *G.* Rhabarber; *Du.* rabarber; *Da.* rhabarber; *Sw.* rabarber; *Gr.* ραβέντιον; *R.* ревенъ, revén'; *Arab.*, *Pers.* rawund; *Hind.* rawunchenee; *Tam.* variattoo kalang.

RICE (*Gr. through Lat.* oryza).—*F.* riz ; *It.* riso ; *Sp.*, *P.* arroz ; *G.* Reis ; *Du.* rijst ; *Da.* riis ; *Sw.* ris ; *Gr.* ὄρυζα ; *R.* рисъ, rīss, сарачинское пшено, saratshīnskoë pshenó ; *Arab.* aruz ; *Pers.* berung ; *Hind.* chawl ; *Guz.* chooka ; *Sans.* vrihi ; *Tam.* arisee ; *Mal.* bras.

ROSE (*Lat.* rosa).—*F.* rose ; *It.*, *Sp.*, *P.* rosa ; *G.* Rose ; *Du.* roos ; *Da.*, *Sw.* rose ; *Gr.* ῥόδον ; *R.* роза, rozá ; *Arab.* wurd ; *Pers.*, *Hind.*, *Guz.*, *Beng.* gul ; *Tam.* gulaba poo ; *Mal.* mawar.

RUBY (*from Lat.* ruber, *red*).—*F.* rubis ; *It.* rubino ; *Sp.* rubí ; *P.* rubim ; *G.* Rubin ; *Du.* robijn ; *Da.*, *Sw.* rubin ; *Gr.* ρουμπίνιον ; *R.* лалъ, lall, рубинъ, rubīn.

RYE (*Ags.* ryge ; *Lat.* secale).—*F.* seigle ; *It.* segala ; *Sp.* centeno ; *P.* senteio, centêo ; *G.* Roggen ; *Du.* rogge ; *Da.* rug ; *Sw.* råg ; *Gr.* βρίζα, σεκάλη ; *R.* рожь, rozh'.

SABLE (*Russ.*).—*F.* sable ; *It.* zibellino ; *Sp.* cebellina ; *P.* zibelina ; *G.* Zobel ; *Du.* sabel ; *Da.* zobel ; *Sw.* sobel ; *Gr.* σαμόυριον ; *R.* соболь, sóbol'.

SAFFLOWER.—*F.* carthame, saffran bâtard ; *It.* zaffrone ; *Sp.* azafran bastardo ; *P.* açafroa ; *G.* Safflor ; *Du.* saffloer, basterd saffraan ; *Da.*, *Sw.* safflor ; *Arab.* usfar ; *Sans.* kussumba, kuma lottora ; *Beng.* koosum, kajeera ; *Hind.*, *Mal.* kussumba ; *Tam.* sendorkum.

SAFFRON (*Arab.* ssafrā, *yellow, through Spanish*).—*F.* safran ; *It.* zafferano ; *Sp.* azafran ; *P.* açafrão ; *G.* Saffran ; *Du.* saffraan ; *Da.* saffran ; *Sw.* saffran ; *Gr.* κρόκος ; *R.* шафранъ, shafránn ; *Arab.* zaifran ; *Pers.* abeer, kurkam ; *Hind.* keysur, zaifran ; *Sans.* kasmira janma, kunkama ; *Tam.* khoon goomapoo ; *Cing.* khohoon ; *Mal.* safaron.

SAGO.—*F.* sagou ; *It.* sagu ; *Sp.* sagú ; *P.* sagu ; *G.*, *Du.*, *Da.*, *Sw.* Sago ; *R.* саго, sagho ; *Hind.* sagoo, sagoo-chawl ; *Tam.* show-arisee ; *Beng.* sagoodana ; *Mal.*, *Jav.*, *Bali*, sagu ; *Chin.* sekuhme.

SAL-AMMONIAC, MURIATE OF AMMONIA.—*F.* sel ammoniac ; *It.* sale ammoniaco ; *Sp.* amoniáco, sal amoniáca ; *P.* sal ammoniaco ; *G.* Salmiak ; *Du.* ammoniak zout ; *Da.*, *Sw.* salmiak ; *Gr.* ἀμμονιακός ; *R.* нашатырь, nashatýr ; *Arab.* urmena ; *Pers.* nowshadur ; *Sans.* nowsadur ; *Hind.*, *Guz.* nowsadur, nowsagur ; *Tam.* navacharum ; *Cing.* vayvagarra loonoo.

SALMON (*Lat.* salmo).—*F.* saumon ; *It.* salmone ; *Sp.* salmon ; *P.* salmão ; *G.* Salm, Lachs ; *Du.* zalm ; *Da.*, *Sw.* lax ; *Gr.* σαλμών ; *R.* семга, sémgha.

SALT (*Ags.* sealt ; *Lat.* sal).—*F.* sel ; *It.* sale ; *Sp.* sal ; *P.* sal ; *G.* Salz ; *Du.* zout ; *Da.* salt ; *Sw.* salt ; *Gr.* ἅλας ; *R.* соль, sol' ; *Arab.* melh ; *Pers.* nun, shora ; *Sans.* lavana ; *Hind.* neemuck ; *Tam.* oopoo ; *Cing.* loonoo ; *Mal.* gharam ; *Jav.* uyah.

SAND (*Ags.* sand ; *Lat.* arena).—*F.* sable ; *It.* arena ; *Sp.* arena ; *P.* areia ; *G.* Sand ; *Du.* zand ; *Da.*, *Sw.* sand ; *Gr.* ἄμμος ; *R.* песокъ, pesók.

SANDALWOOD, SANDERS (*Arab.* ssandal ; *Lat.* santalum, sandalum).—*F.* santal ; *It.*, *Sp.*, *P.* sandalo ; *G.* Sandelholz ; *Du.* sandelhout ; *Da.* sandeltræ ; *Sw.* sandelträd ; *Gr.* κοκκινόξυλον ; *R.* сандалое дерево, sandáloë dérevo ; *Arab.*, *Pers.* sundul ; *Hind.*, *Guz.* sundul, sookur ; *Sans.* chandana Malayaja ; *Beng.* chandana ; *Tam.* chandanum ; *Cing.* sandoon ; *Mal.* Tsjendana ; *Chin.* tan-muh.

SAPPHIRE (*Heb. and Arab.* ssaphīr, *through Gr. and Lat.*).—*F.* saphir ; *It.* zaffiro ; *Sp.* zafir ; *P.* safira ; *G.* Sapphir ; *Du.* saffier ; *Da.* saphir ; *Sw.* safir ; *Gr.* σαφείριον, ζαφίριον ; *R.* сапфиръ, sapfīr.

SARSAPARILLA.—*F.* salsepareille ; *It.* salsapariglia ; *Sp.* zarzaparilla ; *P.* sarsaparrilha ; *G.* Sarsaparillo, Sassaparille ; *Du.* sarsaparille ; *Da.*, *Sw.* sassaparill ; *Gr.* σαπαρίνα ; *R.* сассапарилъ, sassaparíll ; *Arab.* muckwy ; *Sans.* shariva ; *Tam.* nunnarivayr ; *Cing.* erramasoomul, irimusa.

SCAMMONY (*Gr. through Lat.*).—*F.* scammonée ; *It.* scammonea ; *Sp.*, *P.* escamonéa ; *G.* Scammonie, Purgirwinde ; *Du.*, *Da.*, *Sw.* Scammonium ; *Gr.* σκαμμωνία ; *R.* песья смерть, pessya smert' ; *Arab.*, *Hind.* sukmoonia.

SEAL (*Ags.* seol, seolh ; *Lat.* phoca).—*F.* veau marin ; *It.* vitello marino ; *Sp.* foca ; *P.* phoca ; *G.* Seehund, Seekalb ; *Du.* zeehond ; *Da.* sæl (hund) ; *Sw.* själhund, sjökalf ; *Gr.* φώκη ; *R.* тюлень, tyulen'.

SENNA (*Arab.*).—*F.* séné ; *It.*, *Sp.* sena, sen ; *P.* sene, senne ; *G.* Senespflanze ; *Du.* zenebladen ; *Da.* sennesblade ; *Sw.* sennesblad ; *R.* Александрiйскiй листъ, Aleksándriĭskiĭ līst, *i.e.*, Alexandrian leaf ; *Arab.* suna ; *Sans.* butallapotaka ; *Beng.* sana-pat ; *Hind.* soonamukee ; *Tam.* nilaverei, nilavaghei ; *Cing.* nilaverei.

SHAMMEY, or CHAMOIS.—*F.* chamois ; *It.* camozza ; *Sp.* gamuza ; *P.* camurça ; *G.* Gemse ; *Du.* gems ; *Da.* steenged (simslæder) ; *Sw.* stenget (s-läder) ; *Gr.* ἀγρίογιδα ; *R.* серна, замша, serna, zamsha.

SHEEP (*Ags.* sceap ; *Lat.* ovis, pecus).—*F.* brebis ; *It.* pecora ; *Sp.* oveja ; *P.* carneiro ; *G.* Schaf ; *Du.* schaap ; *Da.* faar ; *Sw.* får ; *Gr.* πρόβατον ; *R.* овца, ovtsá.

SHRIMP (*Ger.* schrumpfen, *to shrivel*).—*F.* chevrette ; *It.* squilla ; *Sp.* camaron ; *P.* camarão ; *G.* Garnele ; *Du.* garnaal ; *Da.* reie ; *Sw.* räka ; *R.* морской рачекъ, morskóĭ ratshók.

SILK (*Ags.* seolc, *comp. Da. and Sw.*).—*F.* soie ; *It.* seta ; *Sp.*, *P.* seda ; *G.* Seide ; *Du.* zijde ; *Da.* silke ; *Sw.* silke, siden ; *Gr.*

*μέταξα* ; *R.* шелкъ, sheólk ; *Pers.* ab-rashum ; *Hind.* rasum, rashum.

SILVER (*Ags.* seolfer ; *Lat.* argentum ; *Celtic,* airgiod).—*F.* argent ; *It.* argento ; *Sp.* prata ; *P.* plata ; *G.* Silber ; *Du.* zilver ; *Da.* sölv ; *Sw.* silfwer ; *Gr.* ἀργύριον ; *R.* серебро, serebró ; *Arab.* fazzeh ; *Pers.* nokra ; *Sans.* rajata, rupya ; *Hind.* nugdee, chandee ; *Tam.* vellie ; *Cing.* peddie ; *Mal.* perak ; *Chin.* yin.

SKINS (*Ags.* ? *Da.*).—*L.* pelles ; *Fr.* peaux ; *It.* pelli ; *Sp.* pieles ; *P.* pelles ; *G.* Felle ; *Du.* vellen ; *Da.* skind ; *Sw.* skinn ; *Gr.* δέρματα, πέτζια ; *R.* кожи, kózhī ; *Pers.* churm ; *Hind.* chumra ; *Guz.* chamro.

SLATE (*F.* éclat ; *Old Fr.* esclat, *a splinter, a split*).—*F.* ardoise ; *It.* lavagna ; *Sp.* pizarra ; *P.* ardosia ; *G.* Schiefer ; *Du.* lei ; *Da.* skifersteen ; *Sw.* skifersten ; *Gr.* ἀρδωσία ; *R.* аспидъ, áspīd.

SLAVE (*Ags.* wealh, *a Welshman ; Ger.* Sklave, *a Slavonian ; Lat.* servus, *a Servian*).—*F.* esclave ; *It.* schiavo ; *Sp.* esclavo ; *P.* escravo ; *G.* Sklave ; *Du.* slaaf ; *Da.* slave ; *Sw.* slaf ; *Gr.* σκλάβος, δοῦλος ; *R.* невольникъ, nevólnīk (*i.e.,* an involuntary).

SNOW (*Ags.* snáw ; *Lat.* nix, *orig.* snix, snivis).—*F.* neige ; *It.* neve ; *Sp.* nieve ; *P.* neve ; *G.* Schnee ; *Du.* sneeuw ; *Da.* snee ; *Sw.* snö ; *R.* снѣгъ, snyêgh.

SOAP (*Ags.* sápe ; *Lat.* sapo). —*F.* savon ; *It.* sapone ; *Sp.,* jabon ; *P.* sabão ; *G.* Seife ; *Du.* zeep ; *Da.* sæbe ; *Sw.* tvål, såpa ; *Gr.* σαπούνιον ; *R.* мыло, mylo ; *Arab.*, *Hind.*, *Mal.* saboon ; *Tam.* natsowcaram.

SODA (*Ger.*).—*F.* soude ; *It.*, *Sp.*, *P.* soda ; *G.* Aetznatron, Soda ; *Du.*, *Da.*, *Sw.* soda ; *R.* сода, soda ; *Arab.* jumdchenee ; *Pers.* sajee-khar, papud-khar ; *Hind.* sedjee-mittee, sajeekhar, papud-khar ; *Sans.* sarjica, sarjikashara ; *Tam.* karum, ponheer karum ; *Mal.* charum.

SPERMACETI (*Lat.*, *i.e.*, sperm of the whale).—*F.* blanc de baleine ; *It.* bianco di balena ; *Sp.* espermaceti ; *P.* espermacete ; *G.* Wallrath ; *Du.* spermaceti ; *Da.* hvalrav ; *Sw.* hvalrafs-olja ; *R.* китовый жиръ, kītóvyĭ zhīr.

SPICES.—*F.* épices, épiceries ; *It.* spezj, spezierie ; *Sp.* especias, especerias ; *P.* especiaria ; *G.* Spezereien ; *Du.* specerijen ; *Da.* speceri, kryderi ; *Sw.* speceri, krydda ; *Gr.* ἀρώματα, πακαλικά ; *R.* пряные кореньа, pryánye kórenya, прянохранилише, pryano khranílishtshe ; *Hind.*, *Guz.* gurm mussala.

SPONGE (*Ags.* spinge, *from Lat.* spongia).—*F.* éponge ; *It.* spugna ; *Sp.*, *P.* esponja ; *G.* Schwamm ; *Du.* spons ; *Da.*, *Sw.* svamp ; *Gr.* σφουγγάριον ; *R.* губка, ghubka ; *Arab.* isfeng ; *Pers.* abermoordeh ; *Hind.* mooabadul.

SQUILL (*Lat.* scilla).—*F.* oignon de mer; *It.* cipolla squilla; *Sp.* cebolla albarrana; *P.* scilla; *G.* Meerzwiebel; *Du.* zeeajuin; *Da.* sölög; *Sw.* hafslök; *R.* морской лукъ, morskóĭ luk (=sea-onion).

STARCH (*Ags.* steare, *stiff; Gr.* ἄμυλον; *Lat.* amylum).—*F.* amidon; *It.* amido; *Sp.* almidon; *P.* gomma de trigo; *G.* Stärke; *Du.* stijfsel; *Da.* stivelse; *Sw.* stärkelse; *Gr.* ἄμυλον, καταστατός; *R.* крахмалъ, krakhmáll; *Arab.* abgoon; *Pers.* neeshashta.

STEEL (*Ags.* stýl).—*F.* acier; *It.* acciajo; *Sp.* acero; *P.* aço; *G.* Stahl; *Du.*, *Da.* staal; *Sw.* stål; *Gr.* χάλυψ, τζελίκιον; *R.* сталь, stal'; *Pers.*, *Hind.* foulad'.

STONE (*Ags.* stán; *Lat.* lapis, petra, *from Gr.* πετρα).—*F.* pierre; *It.* pietra; *Sp.* piedra; *P.* pedra; *G.* Stein; *Du.* steen; *Da.* steen; *Sw.* sten; *Gr.* πέτρα, λίθος; *R.* камень, kámen'.

STRAW (*Ags.* streow; *Lat.* palea, *chaff*).—*F.* paille; *It.* paglia; *Sp.* paja; *P.* palha; *G.* Stroh; *Du.* stroo; *Da.* straa; *Sw.* strå; *Gr.* ἄχυρα; *R.* солома, soloma.

STURGEON (*Lat.* sturio).—*F.* esturgeon; *It.* storione; *Sp.* esturion; *P.* robalo; *G.* Stör; *Du.* steur; *Da.*, *Sw.* stör; *Gr.* ξυρύχιον, μουρόυνα; *R.* осетръ, osétr.

SUGAR (*Lat.* saccharum; *Gr.* σάκχαρον, *from Heb. and Arab.* ssakhar; "the honey got from reeds called σάκχαρι," *Pliny*).—*F.* sucre; *It.* zucchero; *Sp.* azúcar; *P.* assucar, açucar; *G.* Zucker; *Du.* suiker; *Da.* sukker; *Sw.* socker; *Gr.* ζάχαρη; *R.* сахаръ, sakhar; *Arab.* sukkur; *Pers.* shakur; *Hind.* shukar; *Sans.* sarkara; *Tam.* sakkara; *Mal.* goola.

SULPHUR, or BRIMSTONE (*Lat.* sulphur).—*F.* souffre; *It.* zolfo; *Sp.* azufre; *P.* enxofre; *G.* Schwefel; *Du.* zwavel; *Da.* svovl; *Sw.* svafvel; *Gr.* θειάφιον; *R.* сѣра, syêra; *Arab.* kibreet; *Pers.* gowgird; *Sans.* gandhaka; *Hind.* gunduck; *Tam.* gendagum; *Cing.* gundaka; *Mal.* blerong; *Chin.* lew.

SUMACH (*Pers.*).—*F.* sumac; *It.* sommaco; *Sp.* zumaque; *P.* sumagre; *G.* Sumak, Sumach; *Du.* smak; *Da.*, *Sw.* sumak; *Arab.* tumtum; *Pers.* shūmakh.

TALC (*Germ*).—*F.* talc; *It.*, *Sp.*, *P.* talco; *G.* Talk; *Du.* talkaarde; *Du.* talk (steen); *Sw.* talk; *Gr.* μαρκάσιον; *R.* талкъ, talk, мыловка, mylovka; *Arab.* kobuk-al-arz; *Pers.* tulk; *Sans.* abraka; *Hind.* abruck, tulk; *Tam.* appracum; *Cing.* minirum.

TALLOW (*Ags.* tealh; *Lat.* seba).—*F.* suif; *It.* sego, sevo; *Sp.*, *P.* sebo; *G.* Talg; *Du.* talk; *Da.* tælle, talg; *Sw.* talg; *Gr.* ὀξύγγιον, στέαρ; *R.* сало, salo; *Arab.* shahum; *Pers.* peeh; *Sans.* govapa; *Hind.* churbee; *Tam.* maat kolupoo; *Cing.* hurruk-tail; *Mal.* lemakchair.

TAMARIND (*Pers.*, *Gr. through Lat.* Tamarindus).—*F.* tamarin; *It.*, *Sp.*,

*P.* tamarindo; *G.*, *Du.*, *Da.* Tamarinde; *Sw.* tamarinder; *Gr.* ταμάρινδος; *R.* тамариндъ, tamarīnd; *Arab.* umblie; *Turk.* demer-hindee; *Pers.* Tumr-i-hindee, *i.e.*, date of India; *Sans.* amlika, tintili; *Hind.*, *Guz.* amblee; *Tam.* poollie; *Cing.* mahasi-ambala; *Mal.* neghka; *Jav.* kamal.

TAR (*Ags.* tearo, tyro).—*F.* goudron; *It.* pece liquida, catrame; *Sp.* brea; *P.* alcatrão; *G.* Theer; *Du.* teer; *Da.* tiære; *Sw.* tjära; *Gr.* κατράνη; *R.* деготь, dyóghot.

TEA (*Chinese*, Cha, te).—*F.* thé; *It.* tè; *Sp.* té; *P.* chá; *G.* Thee; *Du.* thee; *Da.* thee; *Sw.* te; *Gr.* τέϊ, τζάϊ; *R.* чай, tchaï; *Turk.* tchai; *Arab.*, *Pers.* chai; *Hind.* cha, cha-ie; *Mal.* teh.

TIMBER (*Ags.* timbrian, *to build; Lat.* materia).—*F.* bois de charpente; *It.* legname; *Sp.* madera; *P.* madeira; *G.* Bauholz; *Du.* timmerhout; *Da.* tömmer; *Sw.* timmer; *Gr.* ξυλέια; *R.* строевой лѣсъ, stroevóĭ lyêss.

TIN (*Lat.* stannum).—*F.* étain; *It.* stagno; *Sp.* estaño; *P.* estanho; *G.* Zinn; *Du.* tin; *Da.* tin; *Sw.* tenn; *Gr.* καλάϊον; *R.* жесть, zhest'; *Arab.* resas, abruz; *Pers.* uzeez; *Sans.* trapu; *Hind.* kullae, ranga; *Tam.* tagarum; *Mal.* tima, falagh; *Chin.* yang-seih.

TOBACCO (*Native Amer.*).—*F.* tabac; *It.* tabacco; *Sp.*, *P.* tabaco; *G.* Taback; *Du.* tabak; *Da.*, *Sw.* tobak; *Gr.* ταμπάκος; *R.* табакъ, tabák; *Arab.* bujjerbhang, tutun; *Turk.* tutun, dokhan; *Pers.* tumbackoo; *Sans.* dhumrapatra; *Hind.* tumbakoo; *Tam.* pogheielley; *Cing.* doon-kola; *Mal.* tambracco; *Jav.* tambroca; *Chin.* sang-yen.

TORTOISE (*Lat.* tortum, *a warlike engine with pent roof, a tortoise*—testudo).—*F.* tortue; *It.* testuggine, tartaruga; *Sp.* tortúga; *P.* tartarugo, cágado; *G.* Schildkröte, *i.e.*, *a shield-toad; Du.* schildpad; *Da.* skildpadde; *Sw.* sköldpadda; *Gr.* άχελώνα; *R.* черепаха, tsherepákha; *Hind.* kachakra; *Mal.* kurakura.

TRUFFLE.—*F.* truffe; *It.* tartufo; *Sp.* criadillas de tierra; *P.* turbara da terra; *G.* Trüffel; *Du.* truffel; *Da.* tröffel, svinerod; *Sw.* tryffel; *Gr.* 'ὕδνον; *R.* трюфель, triouphel'.

TURMERIC (*Lat.* curcuma).—*F.* safran des Indes; *It.* turtumaglio; *Sp.*, *P.* curcuma; *G.* Gelbwurz; *Du.* kurkuma; *Da.* spansk saffran; *Sw.* gurkmeja; *Gr.* κιτρινοκόκκινος; *R.* желтакъ, zheltak, желтый нибирь, zheóltyĭ nibír'; *Arab.* tumr, zur-sood; *Pers.* zurd-choobeh; *Sans.* haridra; *Hind.* hullud, huldee; *Tam.* munjil; *Mal.* mangellacua.

TURNIP (*Ags.* næpe; *from Lat.* napus; Turnip, *from* turbo napus?).—*F.* navet; *It.* rapa; *Sp.*, *P.* nabo; *G.* Rübe; *Du.* raap, knol; *Da.* Roe, hvidroe; *Sw.* rofwa; *Gr.* γογγύδα; *R.* рѣпа, ryêpá.

TURPENTINE (*Gr. through Lat.* Terebinthus).—*F.* térébenthine; *It.*, *Sp.*, *P.* trementina; *G.* Terpentin; *Du.* terpentijn; *Da.*, *Sw.* terpentin; *Gr.* τερέβινθος; *R.* терпентинъ, terpentín, скипидаръ, skīpīdárr; *Arab.* ratenuj-roomie, butum; *Pers.* zungbarie; *Hind.* turpentine.

ULTRAMARINE.—*F.* bleu d'outremer; *It.* oltramarino; *Sp.* ultramar; *P.* azul ultramarino; *G.* Ultramarin; *Du.* berg blaauw; *Da.*, *Sw.* ultramarin; *R.* ултрамаринъ, ultramarīn; *Hind.*, *Guz.* lajvurd.

VANILLA.—*F.* vanille; *It.* vanilla; *Sp.* vainica; *P.* bainha; *G.* Vanille; *Du.* vanilje; *Da.* vanille; *Sw.* vanilj; *Gr.* βανίλια; *R.* ваниль, vaníl'.

VERDIGRIS.—*F.* vert-de-gris; *It.* verderame; *Sp.* cardenillo, verdin; *P.* verdete artificial; *G.* Grünspan; *Du.* kopergroen, groenspaan; *Da.* spanskgrönt; *Sw.* spanskgröna; *Gr.* χάλκανθος; *R.* мѣдянка, mêdyanka; *Arab.*, *Pers.* zungar; *Hind.* chungal; *Sans.* pittalata; *Tam.* vungalap-patchei; *Mal.* sennang.

VINE (*Lat.* vinea).—*F.* cep de vigne; *It.* vigna, vite; *Sp.* vid; *P.* videira; *G.* Weinstock, Rebe; *Du.* wijngaard; *Da.* viintræ; *Sw.* vinstock; *Gr.* ἀμπέλιον; *R.* виноградъ, vīnoghrádd.

VINEGAR (*Ags.* æced; *from Lat.* acetum).—*F.* vinaigre, *i.e.*, *sour wine*; *It.* aceto; *Sp.*, *P.* vinagre; *G.* Essig; *Du.* azijn; *Da.* eddike; *Sw.* ättika; *Gr.* ξύδιον; *R.* уксусъ, úksus; *Arab.* khull; *Pers.* sirka; *Sans.* canchica; *Hind.* sirka; *Tam.* cadi; *Cing.* cadidia; *Mal.* chooka; *Chinese*, tsoo.

VITRIOL (*Lat.* vitriolum).—*F.* vitriol; *It.* vitriuolo; *Sp.*, *P.* vitriolo; *G.* Vitriol; *Du.* vitriool; *Da.* vitriol; *Sw.* vitriol; *Gr.* βιτρίολιον; *R.* купоросъ, kuporóss; *Arab.* rohazim, maulkibrit; *Pers.* arika-gowgird; *Hind.* gunduck-ka-teil; *Tam.* ghendaga travagum; *Cing.* gandaka rasa.

WALNUT (*the* Wealh, *i.e.*, *foreign or Italian nut*).—*F.* noix; *It.* noce; *Sp.* nuez, nogal; *P.* noz; *G.* Wallnuss; *Du.* walnoot; *Da.* valnöd; *Sw.* valnöt; *Gr.* καρύδιον; *R.* грѣцкій орѣхъ, ghryêtskiĭ oryêx; *Arab.* akroot, jows, khusif; *Pers.* char-mughz, geerdighan, jouz-i-roomie; *Hind.* akroot.

WAX (*Ags.* wæx; *Lat.* cera).—*F.* cire; *It.*, *Sp.*, *P.* cera; *G.* Wachs; *Du.* was; *Da.* vox; *Sw.* vax; *Gr.* κηρίον; *R.* воскъ, vosk; *Arab.* shuma; *Pers.* moom; *Sans.* siktha; *Hind.* moom; *Tam.* meloogoo; *Cing.* miettie; *Mal.* lelin.

WHALE (*Ags.* hwæl; *Lat.* balena).—*F.* baleine; *It.* balena; *Sp.* ballena; *P.* balêa; *G.* Wallfisch; *Du.* walvisch; *Da.* hvalfisk; *Sw.* hval(fisk); *Gr.* κῆτος; *R.* китъ, kīt.

WHALEBONE.—*F.* baleine; *It.* balena; *Sp.* ballena; *P.* barba de balea;

*G.* Wallfischbein; *Du.* balein; *Da.* fiskebeen; *Sw.* hvalben; *Gr.* κητώδιον; *R.* китовый усъ, kītovyĭ uss.

WHEAT (*Ags.* hwæte; *Lat.* frumentum).—*F.* blé, froment; *It.* formento, grano; *Sp.*, *P.* trigo (*Lat.* triticum); *G.* Weizen; *Du.* Tarwe; *Da.* hvede; *Sw.* hvete; *Gr.* σιτάριον; *R.* пшеница, pshenītsa; *Arab.* hinteh; *Pers.* gundum; *Hind.* gaon.

WHITE LEAD.—*F.* blanc de plomb; *It.* cerussa; *Sp.* abbayalde, cal de plomo; *P.* alvaiade; *G.* Bleiweiss; *Du.* loodwit; *Da.* blyhvidt; *Sw.* blyhvitt; *Gr.* μολυβοπέτρα, ψιμμύθιον; *R.* бѣлила, byêlila; *Turk.* istibedsh; *Arab.* asfeidaj; *Pers.* suffeidah, kash; *Hind.*, *Guz.* suffeïdah; *Tam.* moothoo vullay.

WINE (*Ags.* wín; *Lat.* vinum; *Gr.* οἶνος).—*F.* vin; *It.* vino; *Sp.* vino; *P.* vinho; *G.* Wein; *Du.* wijn; *Da.* viin; *Sw.* vin; *Gr.* κρασίον, οἶνος; *R.* вино, vinó; *Arab.* khumr; *Pers.* mei; *Sans.* madira; *Hind.* ungoor-ka-shurab.

WOAD (*Ags.* wád).—*F.* peindre au pastel, guède, vouede; *It.* guado; *Sp.* gualda, yerba pastel; *P.* pastel; *G.* Waid; *Du.* weede; *Da.* vaid; *R.* синильникъ, sīníl'nīk.

WOOD (*Ags.* wudu).—*F.* bois; *It.* legno; *Sp.* leña, palo; *P.* pao, lenha; *G.* Holz; *Du.* hout; *Da.* træ; *Sw.* trä; *Gr.* ξύλον; *R.* дерево, dérevo.

WOOL (*Ags.* wól; *Lat.* lana).—*F.* laine; *It.*, *Sp.* lana; *P.* laa; *G.* Wolle; *Du.* Wol; *Da.* uld; *Sw.* ull; *Gr.* μαλλίον; *R.* шерсть, sherst'; *Pers.* pushm; *Hind.* oonn.

WORMWOOD (*Ags.* wermod; *Lat.* absinthium).—*F.* absinthe; *It.* assenzio; *Sp.* axenjo; *P.* absinthio, losna; *G.* Wermuth; *Du.* alsem; *Da.* malurt; *Sw.* malört; *Gr.* ἄψινθος; *R.* полынь, polýn'; *Arab.* afsunteen; *Pers.* buranjasif kowhei; *Sans.* dona; *Hind.* dhowna, murwa, mustaroo; *Tam.* mashipattirĭ; *Cing.* wael kolundoo.

ZINC, OR SPELTER (*Ger.*).—*F.* zinc; *It.*, *Sp.*, *P.* zinco; *Sp. also* zinc, zinque; *G.*, *Du.* Zink; *Da.*, *Sw.* zink; *R.* цинкъ, шпiаутеръ, tsīnk, shpiáuter; *Pers.*, *Hind.* jussud; *Tam.* tutu-nagum; *Chin.* pi-yuen.

SUMMARY OF THE AREAS OF THE GEOLOGICAL FORMATIONS IN THE BRITISH ISLES = 121,470 SQ. MILES.

| | Formations. | Scotland. | Ireland. | England and Wales. | | | |
|---|---|---|---|---|---|---|---|
| | | Sq. miles. | Sq. miles. | Sq. miles. | | | |
| 1 | Plutonic (Intrusive) | 3,000 | 1,400 | 1,000 | = 5,400 sq. miles of Plutonic rocks (granites, &c.) for *S. I.* E. | 8,000 sq. miles Igneous Rocks | |
| 2 | Volcanic (Eruptive) | 1,100 | 1,400 | 100 | = 2,600 sq. miles of Volcanic rocks for I. S. E. | | |
| | **Total area of Igneous Rocks** | **4,100** | **2,800** | **1,100** | **= 8,000 sq. miles for Igneous Rocks in British Isles** | | |
| 3 | Laurentian | 1,100 | 0? | 0? | = 1,100 sq. miles of Laurentian rocks for *S.* (I. E.) | Palæozoic | Aqueous and (113,470 sq. miles) stratified rocks. |
| 4 | Cambrian | 700 | 300 | 500 | = 1,500 ,, ,, Cambrian ,, *S.* E. I. | | |
| 5 | Silurian | 18,000 | 7,000 | 6,000 | = 31,000 ,, ,, Silurian ,, *S. I. E.* | | |
| 6 | Devonian | 3,000 | 6,000 | 5,500 | = 14,500 ,, ,, Devonian ,, *I. E.* S. | | |
| 7 | Carboniferous | 3,000 | 15,000 | 10,500 | = 28,500 ,, ,, Carboniferous ,, *I.* E. S. | | |
| 8 | Permian | 100 | 0 | 1,000 | = 1,100 ,, ,, Permian ,, *E.* S. (I.) | | |
| | **Total area of Palæozoic Rocks** | **25,900** | **28,300** | **23,600** | **= 77,700 sq. miles for Palæozoic Rocks of British Isles** | **= 77,700** | |
| 9 | Triassic | 20 | 100 | 7,000 | = 7,120 sq. miles of Triassic rocks for *E.* I. S. | Mesozoic | |
| 10 | Jurassic | 0? | 20 | 8,000 | = 8,020 ,, ,, Jurassic ,, *E.* I. (S.) | | |
| 11 | Wealden | 0 | 0 | 1,500 | = 1,500 ,, ,, Wealden ,, *E.* (I. S.) | | |
| 12 | Cretaceous | 0 | 200 | 11,000 | = 11,200 ,, ,, Cretaceous ,, *E.* I. (S.) | | |
| | **Total area of Mesozoic Rocks** | **20** | **320** | **27,500** | **= 27,840 sq. miles for Mesozoic Rocks of British Isles** | **= 27,840** | |
| 13 | Eo-Oligo-cene | 5 | 5 | 3,500 | = 3,510 sq. miles of Eo-Oligo-cene rocks for *E.* I. S. | Caïnozoic | |
| 14 | Miocene | 0 | 0 | 0 | = 0 ,, ,, Miocene ,, (E. I. S.) | | |
| 15 | Pliocene | ? | Bogs 1,000 | Crag, 1,500 | = 2,500 ,, ,, Pliocene ,, *E.* I. (S.) | | |
| 16 | Pleistocene (Glacial) | 60 | ? | 1,000 | = 1,060 ,, ,, Pleistocene ,, *E.* S. (I.) | | |
| 17 | Post-Glacial to Recent | 160 | 100 | 600 | = 860 ,, ,, Post-Glac. to Rec. ,, E. I. S. | | |
| | **Total area of Caïnozoic Rocks** | **225** | **1,105** | **6,600** | **= 7,930 sq. miles for Caïnozoic Rocks of British Isles** | **= 7,930** | |

## Geographical Distribution of all Geological Formations of the British Islands.

| Formations. | Localities. |
|---|---|
| Recent and Pre-historic | **Marine silt** all along the **coasts**, especially the **Western**; on the Eastern, where the sea is gaining on the land, no silt is left high and dry now, although at a not remote period the **Fens of Cambridgeshire**, Norfolk, and **Lincoln** were left to tell their tale.<br>**Alluvial soil** (river silt) is found everywhere more or less near the mouth of rivers, especially **Thames, Severn.**<br>**Upper cave earth** (*ovi-bovine period*) **of Caves of Somerset**, &c.<br>**Intermediate cave earth** (*hyena and bear period*) **of Caves of Somerset, Yorkshire**, &c.<br>The **Crannoges of Ireland**, the **Tumuli of Scotland** and N. England, the **Brandon** flint **quarry**, the **Hoxne** flint **factory**, belong to this epoch. |
| Pleistocene | Patches of glacial drift and lines of foundlings (erratic blocks) all over the British Isles N. of 50° latitude, especially on **Norfolk and Yorkshire coasts**, Northern counties of England, and at **Finchley** near London.<br>**Lower cave earth** (*machairodus period*) of Kent hole (Devonshire), &c. |
| Pliocene | **Crag of Suffolk** and part of Norfolk.<br>**Swamped forests** (*bogs*) of Ireland with megaceros hibernicus. |
| Miocene | Missing. (The Hempsted Hill deposits, Mull's leaf bed, &c., formerly classed as Miocene, are Oligocene, uniting Eocene and Miocene.) |
| Eocene | **London basin**, Hampshire (**Bournemouth**), **Isle of Wight** (Northern half), **Isle of Sheppey**, Dorset, Antrim (N. Ireland), Isle of Mull's leaf beds. |
| Cretaceous | **Gault**—Sussex, Surrey, Kent (**Folkestone**, Chislehurst).<br>**Greensand and Kentish** rag—Kent, Surrey, Sussex (**Sevenoaks, Maidstone**, Shanklin, &c.)<br>**Chalk** — S. E. England (Charlton, **Croydon, Gravesend, Ramsgate, Dover**, Needles (Isle of Wight, Norfolk (subsoil), **Yorkshire** (Flamborough), **Warminster.** |

## Geographical Distribution of all Geological Formations of the British Islands—*continued.*

| Formations. | Localities. |
|---|---|
| Wealden | Kent and Sussex (**Riverhead**, Maidstone, Hastings, Tunbridge), Brooks (Isle of Wight). |
| Oolite | N.E. Yorkshire (**Scarborough**), Gloucestershire (**Bath**), Mendip Hills (**Cheltenham**), Wiltshire, **Oxford**, **Portland**, **Purbeck**. |
| Lias | Yorkshire coast (**Whitby**), Dorset (**Lyme Regis**). |
| Rhætic and Trias | Trias—**Cheshire**, Worcestershire, Devon.<br>Rhætic—Bone beds of **Penarth** (Bristol) and **Westbury-on-Severn.** |
| Dias or Permian | Narrow band in C. England (chiefly in **Yorkshire**) stretching from Nottingham through Pontefract and Ripon to Sunderland and South Shields. |
| Carboniferous | **South Wales** (anthracite and bituminous coal).<br>**Durham, Yorkshire,** and S. Scotland (bituminous coal).<br>**Derbyshire** (coal and mountain limestone).<br>**Somerset** (mountain or cave limestone). |
| Devonian | S., C., and E. Scotland (**Caithness**, Elgin, **Cromarty**), Orkneys [old red sandstone].<br>Devonshire and N. Cornwall (**Plymouth**, Torquay, **Tintagel**), limestone and shales.<br>**S. Wales.** |
| Silurian | South (and N.) Wales, Shropshire (**Caradoc, Bala, Llandeilo**, Snowdon), Lower Silurian.<br>(**Llandovery**, Cader Idris), Middle Silurian.<br>(**Ludlow**, Stiper stones), Upper Silurian.<br>Tyrone, **Wexford**, Kildare (Ireland), Lower Silurian.<br>North and Central Scotland (mostly metamorphosed). |
| Cambrian | N. Wales (**Harlech** and **Bangor**), Cumberland, Shropshire, **Wicklow** and **Wexford**, N. Scotland. |
| Laurentian | N.W. Scotland and Hebrides (**Lewis**), Ireland (Connemara). |
| Pre-Laurentian | Not yet fully and accurately determined. N.W. Wales? N.W. Scotland? |

## Horizontal Sections across England and Wales.

### I.—Cainozoic Strata (S.E. England), viz., Lowestoft to London.

| | | | | | |
|---|---|---|---|---|---|
| About 100 miles. | **Lowestoft** | Diluvium<br>Drift, Boulder Clay | **Recent**<br>**Pleistocene** | Quaternary | **CAINOZOIC.** |
| | Ipswich | Crag | **Pliocene** | Tertiary | |
| | (Missing) | Molasse | **Miocene** | | |
| | **London** | London and Plastic Clay | **Eocene** | | |

### II.—Cainozoic and Mesozoic (E. to W. of England), viz., Aldborough (Suffolk) to Bristol.

| | | | | | | |
|---|---|---|---|---|---|---|
| About 200 miles. | **Aldborough** | Diluvium<br>Drift, Boulder Clay | **Recent**<br>**Pleistocene** | | Quaternary | **CAINOZOIC.** |
| | Woodbridge Ipswich | Crag | **Pliocene** | | Tertiary | |
| | (Missing) | Molasse | **Miocene** | | | |
| | Ipswich—Sudbury | London and Plastic Clay | **Eocene** | | | |
| | Sudbury—Luton Dunstaple | Chalk and Chalk Marl | Upper | **Cretaceous** | | **MESOZOIC.** |
| | Aylesbury | Green Sand and Gault | Lower | Neocomian | | |
| | (Missing) | Weald Clay and Hastings Sand | **Wealden** | | | |
| | Aylesbury—Thame | Portland Rock and Kimmeridge Clay | Upper | **Oolite** | Jurassic | |
| | Oxford—Faringdon | Calcareous Grit and Coral Rag | | | | |
| | Oxford—Malmesbury | Oxford Clay | Middle | | | |
| | Malmesbury—Marshfield | Great and Inferior Oolite | Lower | | | |
| | Chipping Sodbury | Fissile Blue Clays and Shales | **Lias** | | | |
| | **Bristol** | Upper New Red Sandstone | **Trias** | | | |

*N.B.*—The reason why such neat and complete sections can be found in the British Isles (especially in England) is that all the formations (except Miocene) are found to run parallel (or nearly so) to one another, and have the same trend, viz., N.E. to S.W. The Trias and Permian are the only formations somewhat irregular in their distribution, although they share the same general direction.

## Horizontal Sections across England and Wales—*continued.*

### III.—Mesozoic (South to Centre England), viz., Marlborough to Henley-in-Arden, or Southampton to Birmingham.

| | | | | | | |
|---|---|---|---|---|---|---|
| 120 miles. | **Southampton** | London & Plastic Clay | **Eocene** | | | **CAINOZOIC.** |
| 120 miles.; 70 miles. | **Marlborough** | Chalk and Chalk Marl | Upper | **Cretaceous** | Neocomian | **MESOZOIC.** |
| | Swindon | Green Sand and Gault | Lower | **Cretaceous** | Neocomian | |
| | (Missing) | Weald Clay and Hastings Sand | **Wealden** | | Neocomian | |
| | Swindon | Portland Stone and Kimmeridge Clay | Upper | **Oolite** | Jurassic | |
| | (West of) Faringdon | Calcareous Grit and Coral Rag | Upper | **Oolite** | Jurassic | |
| | (East of) Cirencester | Oxford Clay | Middle | **Oolite** | Jurassic | |
| | Winchcombe | Great & Inferior Oolite | Lower | **Oolite** | Jurassic | |
| | (West of) Stratford-on-Avon | Fissile Blue Clays and Shales | **Lias** | | Jurassic | |
| | **Henley-in-Arden** | Upper New Red Sandstone | **Trias** | | Saliferous, Gypsiferous, and New Red | |
| | **Birmingham** | Magnesian Limestone | **Upper Permian** | | Saliferous, Gypsiferous, and New Red | **PALÆOZOIC.** |

### IV.—Mesozoic and Palæozoic (S.E. of England to S. of Scotland), viz., London to Edinburgh or St. Albans to Selkirk.

| | | | | | | |
|---|---|---|---|---|---|---|
| 380 miles. | **London** | London & Plastic Clay | **Eocene** | | | **CAINOZOIC.** |
| 380 miles.; 330 miles. | **St. Albans** | Chalk and Chalk Marl | Upper | **Cretaceous** | Neocomian | **MESOZOIC.** |
| | Stratford | Green Sand and Gault | Lower | **Cretaceous** | Neocomian | |
| | (Missing) | Weald Clay and Hastings Sand | **Wealden** | | Neocomian | |
| | Bedford | Portland Stone and Kimmeridge Clay | Upper | **Oolite** | Jurassic | |
| | Missing (but found 30 miles W.) | Calcareous Grit and Coral Rag | Upper | **Oolite** | Jurassic | |
| | Bedford | Oxford Clay | Middle | **Oolite** | Jurassic | |
| | Northampton | Great & Inferior Oolite | Lower | **Oolite** | Jurassic | |
| | Melton Mowbray | Fissile Blue Clays and Shales | **Lias** | | Jurassic | |
| | Nottingham | Upper New Red Sandstone | **Trias** | | Saliferous, Gypsiferous, New Red | **PALÆOZOIC.** |
| | (Near) Chesterfield | Magnesian Limestone | Upper | **Permian** | Saliferous, Gypsiferous, New Red | |
| | Do. | Lower New Red Sandstone | Lower | **Permian** | Saliferous, Gypsiferous, New Red | |
| | L'ds, Brough Allstone | Carboniferous | **Carboniferous** | | | |
| | Hawick and Riccarton | Devonian (Old Red) | **Devonian** | | | |
| | **Selkirk** | Silurian | **Silurian** | | | |
| | (Missing) | But found N.W. Wales, N.W. England, N.W. Scotland | **Cambrian** | | | |
| | (Missing) | Do. do. | **Laurentian** | | | |
| | **Edinburgh** | Carboniferous crops up again | | | | |

## Analysis of the Chief Substances serving as Essential or Accessory Food to Man.

| | | Fat Formers. | Flesh Formers. | Salts. | Nutriment in 100 parts. |
|---|---|---|---|---|---|
| Carbonaceous, heat-giving food. Lung power. | Suet—Vegetable and animal butter. Fat — Vegetable and animal oil . . . | 100 | 0 | 0 | 100 |
| | Sugar . . . . . . | 100 | 0 | 0 | 100 |
| | Rice . . . . . . | 92 | 7 | 1 | 99 |
| | Cocoa-nibs . . . . . | 86 | 10 | 3 | 96 |
| | Sago, arrowroot, tapioca . | 82 | 4 | 1 | 86 |
| | Bacon . . . . . . | 63 | 8 | 1 | 71 |
| | Dry fig . . . . . | 73 | 6 | 2 | 79 |
| | Jerusalem artichoke . . | 69, 89 | 5 | 3 | 73, 93 |
| | Dry date . . . . . | 63 | 2, 3 | 2 | 65 |
| | Potato . . . . . . | 12, 16, 22 | 2 | 1 | 14, 18, 24 |
| | Carrot . . . . . . | 12, 18 | 1, 6 | 1 | 13, 24 |
| | Parsnip . . . . . | 8, 18 | 2 | 1 | 10, 20 |
| | Beetroot . . . . . | 12 ? | ? | ? | 15 |
| Carbo-Nitrogeneous, heat and flesh forming. Lung and Muscle power. | Indian meal . . . . . | 75 | 11 | 1 | 86 |
| | Oat meal . . . . . | 69 | 17 | 3 | 86 |
| | Barley meal . . . . . | 68 | 14 | 2 | 82 |
| | Wheat flour . . . . | 55, 66, 73 | 11, 13 | 1 | 79, 95 |
| | Wheat grain . . . . | 55, 68 | 12 | 2 | 67, 80 |
| | Wheat bran . . . . | 55 | 14, 16 | 6 | 70 |
| | Wheat husk . . . . | 55 | 15 | 6 | 70 |
| | Barley . . . . . . | 55, 67 | 10, 12 | 3 | 67, 92 |
| | Maize . . . . . . | 50, 70 | 10, 12 | 2 | 60, 82 |
| | Oats . . . . . . | 50, 64 | 10, 15 | 3 | 60, 75 |
| | Buckwheat . . . . . | 52 | 8, 10 | 2 | 60 |
| | Rye . . . . . . | 55, 66 | 3, 9, 15 | 1 | 58, 78 |
| | Bread . . . . . . | 49 | 6, 7 | 2 | 56 |
| | Apple . . . . . . | ? | ? | ? | 17 |
| | Pear . . . . . . | ? | ? | ? | 16 |
| | Milk . . . . . . | 8 | 5 | 1 | 13 |
| Nitro-Carbonaceous. Mainly Flesh forming and Muscle power. | Eggs . . . . . . | ? | About 95 | ? | 95 |
| | Dry peas . . . . . | 23 | 60 | 3, 8 | 83, 93 |
| | Green peas . . . . . | 7 | 36 | 2 | 43 |
| | Lentils . . . . . | 40 | 38 | 8 ? | 78 |
| | Beans . . . . . . | 45 | 24, 28 | 6 ? | 73, 89 |
| | Cheese . . . . . | 25 | 31 | 5 | 56 |
| | Cooked meat . . . . | 14 | 22 | 1 | 36 |
| | Fish . . . . . . | 7 | 14 | 1 | 21 |
| | Cabbage . . . . . | 5, 10, 15 | 2, 3 | 1 | 7 to 18 |
| | Turnip . . . . . | 6, 8, 10 | 2 to 14 | 1 | 4, 8, 12, 24 |
| | Radish . . . . . | 1 | 1 | 2 | 2 |

*N.B.*—In several cases more than one number is given: this is owing to analysts differing considerably.

*Observation.*—The plants yielding food to man may be divided thus:—

(*a*) Leguminosæ seeds yield 32/100 Nitrogenous and 30 to 40/100 Carbonaceous food = 62 to 72/100.

(*b*) Cerealia seeds yield 12/100 Nitrogenous and 65 to 70/100 Carbonaceous food = 77 to 82/100.

(*c*) Endogens: rice, sago, arrowroot; Exogens (Urticacea): tapioca; Exogens (Byttneriaceæ): cacao-nibs — yield 6/100 Nitrogenous and 86/100 Carbonaceous food = 92/100.

(*d*) Vegetables (green) of Cruciferæ and Chicoraceæ yield 2/100 Nitrogenous and 5 to 10/100 Carbonaceous food = 7 to 12/100.
Vegetables (roots and tubers) of Cruciferæ, Chenopodiaceæ, Umbelliferæ, Solanaceæ, yield 2/100 Nitrogenous and 22/100 Carbonaceous food = 24/100.

(*e*) Fruit (dry), as fig and date, yield 4/100 Nitr. and 50 to 60/100 Carb. food = 54 to 64/100.

(*f*) Sugar, vegetable oil, butter, and tallow yield 0/100 Nitr. and 100/100 Carb. food = 100/100.

## Analysis of the Chief Substances serving as Essential or Accessory Food to Cattle.

| | | | Fat Formers. | | Flesh Formers. | Salts. | Nutriment in 100 parts. |
|---|---|---|---|---|---|---|---|
| | | | Starch, Sugar, Oil. | Cellulose.* | | | |
| Natural Food. | Green. | Grass and halm of cereals | 7–24 (15) | 6–17 (10) | 2–5 ($3\frac{1}{2}$) | 1–4 (2) | 25 |
| | Dry. | Hay and straw | 43 (h) 7 (s) | 27 (h) 16 (s) | 8 (h) 4 (s) | 6 (h) 4 (s) | 70 (h) 23 (s) |
| Artificial Food. | Green. | Leaf and stalk of Leguminosæ | 4–17 (12) | 1–28 (8) | 2–8 (5) | 2 | Average 21 |
| | | Buckwheat, rape, mustard, prickly comfrey, yarrow, chicory, cabbage | 4–40 (12) | 1–27 (6) | 1–9 (3) | 1–7 (3) | 21 |
| | | Roots and tubers of Cruciferæ, Chenopodiaceæ, Umbelliferæ, Compositæ, Solanaceæ | 1–89 (15) The average is about 15, but Jerus'lm artichoke is 89. | 1–8 (3) | 1–5 (2) | 1 | 19 |
| | Dry. | Grain of cereals | .. | .. | 5–12 (9) | .. | .. |
| | | Wheat bran, oat meal, wheat husk | 55–78 (66) | 2–9 (4) | 14–16 (15) | 1–6 (2) | 75 |
| | | Buckwheat | 52 | 23 | 8–9 | 2 | 72 |
| | | Leaf and stalk of Leguminosæ | 7–38 (30) | 18–65 (28) | 4–20 (16) | 7 | 60 |
| | | Seeds of Leguminosæ | 23–34 (30) | 9–17 (11) | 19–60 (30–60) | 6–11 (8) | 65–95 |
| | | Plantain, burnet, yarrow | 33–45 (39) | 20–33 (27) | 10–14 (12) | 6–9 (7) | 65 |
| Occasional Food. | Oily Seeds. | Lin, rape, hemp, and cotton seeds | 14–39 (22) | 7–12 (9) | 21–32 (25) | 3–9 (6) | 52 |
| | Oil Cakes. | As above, besides cocoa-nut oil and poppy seed oil | 23–34 (30) | 9–17 (11) | 19–38 (29) | 6–11 (8) | 65 |
| | Cellulose, Lignine, or Woody Fibre. | Of linen rags | 0 | 80 | 0 | ? | 80 |
| | | Of hay | 0 | 65 | 0 | ? | 65 |
| | | Of straw | 0 | 50 | 0 | ? | 50 |
| | | Of poplar | 0 | 48 | 0 | ? | 48 |
| | | Of pine and spruce | 0 | 40 | 0 | ? | 40 |

*N.B.*—The numbers 7–24 (15) at top of page mean that the substance amounts to a number between 7 and 24 (this great difference is mainly owing to some analysts studying the substances in a dry and others in a moist state), and the number in brackets gives the mean between the extremes.

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* *Cellulose* (cellular tissue) unites starch and gum, and, like them, is represented by 36 carbon and 45 water. Neither water, oil, alcohol, or ether can dissolve it, but sulphuric acid converts it into grape or starch sugar; 50/100 of the cellulose is digestible. *Lignine* (woody tissue or fibre) is cellulose indurated by age; not more than 5 to 10/100 is digestible.

## Table I.—VEGETABLE KINGDOM.

The Orders of Plants in any way Useful to Man amount to 153 out of a total of 220, viz.:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Phanerogams** | Exogenous plants contain | 122 | useful orders out of | 181. |
| | Endogenous ,, ,, | 23 | ,, ,, ,, | 30. |
| **Cryptogams** | Thallogenous ,, ,, | 3 | ,, ,, ,, | 3. |
| | Acrogenous ,, ,, | 5 | ,, ,, ,, | 6. |

### AS REGARDS THEIR USES.

**Albuminous Food** (*gluten or vegetable fibrin, legumin or vegetable casein*) is obtained
From 23 genera belonging to 3 orders: Graminæ, 12; Leguminosæ, 10; Polygonaceæ, 1.

**Amylaceous Food** (*starch*) is obtained
From 16 genera belonging to 11 orders, chiefly Cycadaceæ, Araceæ, Marantaceæ, Musaceæ.

**Saccharine Food** (*sugar*) is obtained
From 11 genera belonging to 5 orders, chiefly Palmaceæ, 5; Graminæ, 3.

**Edible Fruits** are obtained
From 103 genera belonging to 42 orders, of which 9 comprise 57 genera: Rosaceæ, 16; Urticaceæ, 9; Aurantiaceæ, 6; Myrtaceæ, 5; Palmaceæ, 5; Juglandaceæ, 4; Vacciniaceæ, 4; Coniferæ, 4; Sapotaceæ, 4.

**Miscellaneous Food** is obtained
From 83 genera belonging to 27 orders, of which 5 comprise 43 genera: Algæ, 10; Fungi, 9; Umbelliferæ, 9; Compositæ, 8; Cruciferæ, 7.

**Spices and Condiments** are obtained
From 55 genera belonging to 23 orders, of which 5 comprise 27 genera: Umbelliferæ, 7; Liliaceæ, 7; Lauraceæ, 6; Zingiberaceæ, 4; Solanaceæ, 3.

**Beverage** is obtained
From 60 genera belonging to 37 orders, of which 6 comprise 25 genera: Graminæ, 8; Palmaceæ, 4; Compositæ, 4; Myrtaceæ, 3; Rosaceæ, 3; Urticaceæ, 3.

**Medicines** are obtained
From 215 genera belonging to 84 orders, of which 15 comprise 103 genera: Compositæ, 12; Labiatæ, 10; Solanaceæ, 8; Loganiaceæ, 8; Euphorbiaceæ, 8; Urticaceæ, 7; Rosaceæ, 7; Polygonaceæ, 6; Fungi, 6; Lauraceæ, 5; Myrtaceæ, 5; Asclepiadaceæ, 5; Amentaceæ, 4; Scrophulariaceæ, 4.

## VEGETABLE KINGDOM—*continued.*

### AS REGARDS THEIR USES.

**Cattle Fodder** is obtained
From 43 genera belonging to 13 orders, of which 3 comprise 32 genera: Graminæ, 20; Leguminosæ, 7; Cruciferæ, 5.

**Fixed Oils** are obtained
From 29 genera belonging to 21 orders, of which 6 comprise 14 genera: Cruciferæ, 3; Coniferæ, 3; Amentaceæ, 2; Euphorbiaceæ, 2; Palmaceæ, 2; Sapotaceæ, 2.

**Essential Oils** are obtained
From 33 genera belonging to 15 orders, of which 4 comprise 20 genera: Umbelliferæ, 7; Labiatæ, 6; Aurantiaceæ, 4; Myrtaceæ, 3.

**Gums and Resins** are obtained
From 76 genera belonging to 24 orders, of which 4 comprise 41 genera: Coniferæ, 23; Leguminosæ, 9; Amyridaceæ, 5; Euphorbiaceæ, 4.

**Tanning Material** is obtained
From 16 genera belonging to 11 orders, of which 3 comprise 8 genera: Amentaceæ, 3; Leguminosæ, 3; Myrtaceæ, 2.

**Dyeing Material** is obtained
From 61 genera belonging to 43 orders, of which 3 comprise 17 genera: Leguminosæ, 11; Amentaceæ, 3; Lichenæ, 3.

**Textile Material** is obtained
From 33 genera belonging to 14 orders, of which 3 comprise 17 genera: Urticaceæ, 9; Palmaceæ, 4; Malvaceæ, 4.

**Structural (or Building and Cabinet) Material** is obtained
From 81 genera belonging to 25 orders, of which 4 comprise 55 genera: Coniferæ, 30; Leguminosæ, 14; Urticaceæ, 6; Amentaceæ, 5.

**Material for Miscellaneous Industries** is obtained
From 82 genera belonging to 45 orders, of which 7 comprise 40 genera: Graminæ, 15; Palmaceæ, 7; Amentaceæ, 5; Sterculiaceæ, 4; Algæ, 3; Leguminosæ, 3; Cyperaceæ, 3.

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The above will show how much more elaborate and extensive the natural history of raw materials, and these synopses and charts, might have been made, had it been thought expedient to do so; but entering into minute details would have been against the main object of the book and the synopses and charts, which is to place before the intelligent reader clear and intelligible lists of natural produce, as thorough, and yet as concise, as the proper treatment of the subject will allow.

# Table II.—VEGETABLE KINGDOM.

## Range of all Families of Plants yielding Food to Man.

(*For the distribution of the plants themselves, see further.*)

| | | | | |
|---|---|---|---|---|
| Phanerogamous or Cotyledonous Plants. | Dicotyledonous or Exogenous Plants. | Angiospermous Plants. | Thalamifloræ. | **Cruciferæ** (all zones, chiefly temperate, diminishing North and South), [cabbage, turnip, horse-radish, radish, mustard, cress].<br>**Aurantiaceæ** (torrid and warm temperate), [orange, lemon, citron, shaddock].<br>**Vitaceæ** (torrid and warm temperate), [grape].<br>**Byttneraceæ** (torrid), [theobroma yielding cacao].<br>**Camelliaceæ** (warm temperate), [thea or tea]. |
| | | | Calycifloræ. | **Leguminosæ** (all zones except polar, but chiefly tropical, and diminishing polewards).<br>[*Cold and warm temperate*, peas and beans.<br>*Warm temperate and subtropical*, lentil, soy-bean, chickpea.<br>*Subtropical and torrid*, groundnut, tamarind.]<br>**Rosaceæ** (warm and cold temperate), [raspberry, strawberry, plum, apple, pear, cherry, quince, almond, peach, apricot, nectarine].<br>**Grossulariaceæ** (warm and cold temperate), [gooseberry and currants—red, white, black].<br>**Umbelliferæ** (all zones except polar), [anise, caraway, coriander, cumin, parsley, celery, carrot, pignut, parsnip].<br>**Cucurbitaceæ** (tropical and warm temperate), [pumpkin, vegetable marrow, melon, cucumber].<br>**Myrtaceæ** (torrid and warm temperate), [clove, pimento (allspice), pomegranate]. |
| | | | Corollifloræ. | **Oleaceæ** (*warm temperate* and cold temperate), [olive and flowering ash (yielding manna)].<br>**Solanaceæ** (all zones except polar), [cayenne pepper, chillies, potato, and dangerous poisons].<br>**Labiatæ** (warm and cold temperate), [most herbs used as seasoning, as mints, sage, thymes, savoury, marjoram, besides lavender].<br>**Compositæ** (all zones except polar, chiefly temperate, diminishing North and South), [Jerusalem artichoke, chicory, dandelion, lettuce, and many medicinal plants].<br>**Rubiaceæ** (warm temperate and torrid), [coffee, besides many medicinal barks]. |
| | | | Monochlamidæ. | **Euphorbiaceæ** (all zones except polar), [tapioca of mandioc, castor-oil, besides many poisons].<br>**Urticaceæ** (all zones except polar), [hops, fig, mulberry, cow-tree, jackfruit, and poisons also].<br>**Lauraceæ** (torrid and warm temperate), [cinnamon, cassia, avocado pear].<br>**Piperaceæ** (torrid), [pepper].<br>**Myristicaceæ** (torrid), [nutmeg with mace].<br>**Cupuliferæ** (warm and cold temperate), [hazelnut, chestnut].<br>**Juglandaceæ** (warm and cold temperate), [walnut, hickory nut].<br>**Aceraceæ** (all zones except polar), [sugar-maple]. |
| | | Gymnosperms. | | **Cycadaceæ** (torrid and subtropical), [arrowroot of zamia, bread-fruit of South Africa]. |

RANGE OF ALL FAMILIES OF PLANTS YIELDING FOOD—*continued.*

| | | | | | | |
|---|---|---|---|---|---|---|
| PHANEROGAMOUS OR COTYLEDONOUS PLANTS. | MONOCOTYLEDONOUS OR ENDOGENOUS PLANTS. | DICTYOGENS. | **Dioscoreaceæ** (torrid), [yam]. | | | |
| | | PETALOIDÆ OR FLORIDÆ. | **Palmæ** (torrid and subtropical), [cocoanut, cabbage-palm, sago-palm, oil-palm, date and doom palms, others yielding butter, tallow, sugar]. **Musaceæ** (torrid), [banana, plantain]. **Marantaceæ** (torrid), [true arrowroot]. **Pandanaceæ** (torrid), [pandang fruit]. **Bromeliaceæ** (torrid), [pineapple]. **Liliaceæ** (all zones except polar), [asparagus, leek, onion, chive, shallot]. **Zingiberaceæ** (torrid and subtropical), [ginger]. **Orchidæ** (all zones except polar), [the root of an orchis yields salep (gum starch), another yields vanilla pod]. | | | |
| | | GLUMACEÆ. | **Graminæ** or **Cerealia.** | Mainly cold temperate. | Oats, Rye, Barley. | Range up to 70° North and down to 40° South, but do not thrive in tropical zone, except at great altitude. |
| | | | | Temperate and tropical. | Wheat. | Ranges up to about 60° North and down to 40° South, but thrives best in tropical, subtropical, and warm temperate, not in equatorial. |
| | | | | Tropical. | Rice and Maize. | Subtropical and tropical mainly, but extending into warm temperate and equatorial. |
| | | | | | Sugar-cane, Guinea-corn, or Durra. | As rice and maize in range, but do not extend so far into temperate. |
| CRYPTOGAMS OR ACOTYLEDONOUS PLANTS. | | THALLOGENS. | **Fungidæ** (all zones, but, with Lichenidæ, the only vegetation in polar zone), [*morel, truffle, mushrooms.*] **Lichenidæ** (all zones, but, with Fungidæ, the only vegetation in polar zone), [*Iceland* and *Irish mosses*]. | | | |
| | | ACROGENS. | **Filices** (all zones, except polar; are arborescent in intertropical regions). The rhizome of several contains starch, and is eaten in Australia and Sandwich Isles. | | | |

## Table III.—VEGETABLE

Fruits (whatever their uses to Man) arranged

| | | Form. | Nature. | Quality. | Family. | |
|---|---|---|---|---|---|---|
| Apocarpous, viz., with Single Fruit. | Open irregularly. | Achenium | Dry P. . . . | Medicinal | Anacardiaceæ . | 1. |
| | | | Succulent P. . | Food . . | ,, | |
| | | | Dry P. . . | Medicinal | Compositæ . . | 2. |
| | | | | Food . . | Umbelliferæ. . | 3. |
| | | | | ,, . . | ,, | |
| | | Caryopsis . | | ,, . . | Graminæ . . . | 4. |
| | | Glans (nut) | | ,, . . | Cupuliferæ . . | 5. |
| | | Drupe . | Succulent P. | ,, . . | Rosaceæ . . . | 6. |
| | | | | ,, . . | Various . . . | 7. |
| | Open regularly. | Legume(pod) | Dry P. . . | ,, . . | Leguminosæ . | 8. |
| | | Follicle. . | | Medicinal | Ranunculaceæ . | 9. |
| Syncarpous, viz., Compound Fruit. | | Capsule . | | ,, | Various . . . | 10. |
| | | | | ,, | ,, . . . | |
| | | Siliqua or husk . | | Food . . | Cruciferæ . . | 11. |
| | | | | ,, . . | ,, . . . | |
| | Open irregularly, except Abietinæ. | Bacca or . | Succulent P. | ,, . . | Various . . . | 12. |
| | | | | ,, . . | ,, . . . | |
| | | | | ,, . . | Solanaceæ . . | 13. |
| | | Pepo . . . | | ,, . . | Cucurbitaceæ . | 14. |
| | | Hesperida . | | ,, . . | Hesperidæ . . | 15. |
| | | Pome . . | | ,, . . | Rosaceæ . . . | 16. |
| Artocarpous, viz., Collective Fruits. | | Syconus . . | | ,, . . | Urticaceæ . . | 17. |
| | | Sorosis . | | ,, . . | ,, . . | |
| | | Strobilus | Dry P. . . . | (?) | Abietinæ . . . | 18. |
| | | | Succulent P. . | Food . . | Bromeliaceæ . | 19. |
| | | Bacca-Strobilus | ,, | (?) | Cupressinæ . . | 20. |

*N.B.*—The letter P just above means pericarp or fertilised ovary.

# KINGDOM.

## ACCORDING TO THEIR FORM, NATURE, AND QUALITY.

| | |
|---|---|
| 1. | *Resins:* varnish, lacquer, Chian-turpentine, tan, marking-ink.* |
| | *Fruit* (eaten): pistachio nut, mango. |
| 2. | *Extracts:* veronica, burdock, chamomile, elecampane, dandelion, artemisia, coltsfoot.* |
| 3. | *Stalks:* celery, parsley. *Roots:* carrot, parsnip.* |
| | *Seeds:* cumin, anis (all with mucilage or pectin). |
| 4. | *Seeds* (staff of life): wheat, oats, rye, barley, rice, maize, durra. *Sugar:* sugar-cane. |
| 5. | *Fruit* or *oily* and amylaceous nut: hazel, chestnut. |
| 6. | *Fruit* (*oily*): almond, uniting glans and drupe; olive. (*Succulent*): cherry, plum (&c.), raspberry, blackberry. |
| 7. | *Fruit* (*oily*) of walnut (juglandaceæ); *saccharine* of date (palmæ). |
| 8. | *Seed and pod:* pea, bean, lentil, &c. (all rich *flesh-formers*). |
| 9. | *Fruit and extract* very poisonous (hellebore, aconite, delphinium). |
| 10. | *Fruit and extract* very poisonous: poppy (papaveraceæ).<br>Digitalis (scrophulariæ), henbane (solanaceæ), and euphorbiaceæ. |
| 11. | *Leaf* of cress, mustard, turnip (tops), and of all cabbages.* |
| | *Root* of turnip, radish, horse-radish, seeds of cress, mustard. |
| 12. | *Fruit* of vine (vitaceæ), currants (grossulariaceæ). |
| | *Fruit* of pomegranate (myrtaceæ) and berberry (&c.): berberidaceæ. |
| 13. | *Tuber* (rich in starch) of potato (berry poisonous).* |
| 14. | *Fruit* as vegetable (marrow, cucumber) or as fruit (melon). |
| 15. | *Fruit* of citron, lemon, shaddock, orange. |
| 16. | *Fruit* of most, as apple, pear, quince, medlar, cornus. |
| 17. | *Fruit* of fig-tree. |
| | *Fruit* (viz., cluster of *succulent spike* of bread-fruit, jack-fruit, and mulberry). |
| 18. | *Fruit* or *nut* of some: pine, fir, cedar, larch, spruce (viz., *indurated catkin*), called cone or apple. |
| 19. | *Fruit* (*indurated catkin*) of pine-apple. |
| 20. | *Fruit* (berrylike) of juniper (used for gin, &c.). |

* Means: *fruit not used.*

SYNOPSIS OF THE ALIMENTARY AND INDUSTRIAL PRODUCE OF THE ANIMAL KINGDOM, ARRANGED ACCORDING TO THEIR ANATOMY, NATURE (CHEMICAL AND PHYSICAL), AND USES.

| | | | | | | |
|---|---|---|---|---|---|---|
| ALIMENTARY. | Tissues and Secretions. | Nitrogenous | 1 | Nerve forming (brain power) | A. Fish | Herring, pilchard, sprat, whitebait, sardine, anchovy, mackerel, salmon, cod, haddock, tusk, turbot, sole, plaice, lamprey, sturgeon (with caviare and isinglass), sterlet. **B. Molluscs:** oyster, mussel, cockle, periwinkle, whelk, Ormond whelk. |
| | | | | | C. Crustacea | Crab, lobster, crawfish, crayfish, shrimp, prawn. |
| | | | 2 | Flesh forming (muscle power) | A. Mammals | Ox, calf, sheep, lamb, deer (venison), ham of hog and boar, hare, rabbit; cheese. **B. Birds:** all (except birds of prey), especially the Perchers and Swimmers; also eggs and the edible nest of Javanese swallow. **C. Reptiles:** green and hawk's bill turtles, edible and bull frogs, axolotl. |
| | | | 3 | Flesh-fat forming (muscle and lung power) | Mammals | Hog (bacon, salt pork, &c.), boar; cream and milk of cow, goat, ass, sheep, &c. |
| | | | 4 | Fat forming, heat-giving (lung power) | A. Mammals | Butter, fat, lard—oil of seal. **B. Insects:** honey of bees. |
| INDUSTRIAL. | | Carbonaceous | 5 | Fat | Mammals | *Tallow* of sheep (rich in stearin and poor in olein), ox and horse's *fat*. |
| | | | 6 | Fixed oils (liquid) | A. Mammals | Greenland or right whale, hump-backed whale, finned whale, cachalot or sperm whale (yields spermaceti), beluga or white whale; seals; bone oil. **B. Reptiles:** eggs of turtles. **C. Fish:** cod liver oil (see No. 31 below, and p. 315), and others less known. |
| | | | 7 | Volatile oils or perfumes (solid) | Mammals | Musk deer (moschus, not tragulus or chevrotain), civet cat (civetta and zibetta); beaver (yields castoreum musk); sperm whale or cachalot (yields a biliary calculus called ambergris). |
| | | | 8 | Wax and resin | Insects | *Wax* of bee and other hymenoptera; shellac *resin* of the lac insect (coccus lacca), used for dye stuffs, sealing wax and lacquer. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| INDUSTRIAL. | Frame and covering of the body. | Endo-skeleton | Osseo- Calcareous | 9 | Bones, Teeth, Tusks (compact) | Mammals | *Bones* of all, but mainly of ox and horse; *Teeth* (or ivory-dentine) of narwhal, walrus, hippopotamus; *Tusks* (ivory) of elephant and extinct mastodon. |
| | | | Petro- Calcareous | 10 | Cuttlebone (spongy) Coral (poro-tubular) | A. Molluscs | Spongy calcareous plate or *bone of cuttlefish*, used as dentifrice; replaces also emery and sand paper. **B. Actinozoan Zoophytes:** *Red coral* and others such as gorgonia or seafan, &c. |
| | | | Horny elastic | 11 | Whalebone | Mammals | *Whalebones* from the screen of baleen plates within and on each side of the mouth of toothless whales, especially the Greenland or right whale. |
| | | Endo-Exoskeleton. | Osseo-calcareous | 12 | Cuirass | Reptiles | *Cuirass* of turtles, composed of the exo and the endo-skeleton united; the upper part or shield, and lower part or plastron. |
| | | Exoskeleton. Endoderm. | Petro-calcareous | 13 | Shelly | Molluscs | Cowry (as coin and to glaze earthenware); window shell (placuna placenta), clam shell (as holy water basin), chank shell or turbinella (cut in ringlike ornaments), helmet shell or cassis (made into umbrella-handles and to imitate cameos); tridacna (huge shell used as cradle and bath). |
| | | | Horny-calcareous | 14 | Scaly | Fish | Scales of cycloid bony fish, chiefly those of bleak (cyprinus) to make spurious pearls. |
| | | | | 15 | Scutose | Reptiles | *Turtle-shell* or scute of the green turtle, hawk's bill turtle and carret tortoise—scutes of crocodile, gavial, alligator, caïman (but little used). |
| | | | Silicose | 16 | Vitro-fibrous | Protozoans | Euplectella or Venus flower-basket among siliceous sponges. |
| | | | Osseo-calcareous | 17 | Plated | Mammals | The *coat of mail* of Armadillo, among the edentata (toothless mammals). |
| | | | Horny — Brittle | 18 | Imbricated | Mammals | The *shield* of the scaly anteater, among the edentata (toothless mammals). |
| | | | Horny — Flexible | 19 | Horni-tubular | Protozoans | Washing *sponges*, viz., the Keratose sponges; chiefly from E. Mediterranean Sea, Red Sea, and inferior ones from West Indies. |
| | | | | 20 | Ramose and feathery | Birds | *Ornamental feathers* of ostrich, little egret, great white heron, common heron, adjutant, marabou, bird of paradise, gold pheasant, silver and argus pheasants, peacock, ibis, partridge, ptarmigan, eagle, humming birds, turkey, cock of common fowl. *Bed feathers and down* of swan, goose, duck, eider duck. *Quill pens:* of ostrich, goose, turkey, swan, crow. |
| | | | | 21 | Skinny-leathery | A. Mammals | Morocco leather of goat and deer. Russian and Levantine leather of sheep—chamois leather, kid leather, lamb, and doeskin. Hides of ox, calf, horse, hippopotamus, rhinoceros, elephant. **B. Reptiles:** leather of crocodile, alligator, caïman, gavial. |

SYNOPSIS OF THE ALIMENTARY AND INDUSTRIAL PRODUCE OF THE ANIMAL KINGDOM, ARRANGED ACCORDING TO THEIR ANATOMY, NATURE (CHEMICAL AND PHYSICAL), AND USES—*continued.*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| INDUSTRIAL. | Frame and covering of the body. | Exoskeleton. | Exoderm. | Strongly Nitrogenous; yield Ammonia. | Fibrous | 22 | Fleece | Woolly | Mammals | *Wool* of sheep, moufflon, merino sheep, angora goat, Tibet goat, llama, alpaca, vicuna, guanaco. |
| | | | | | | | | Hairy | Mammals | *Hair* of human beings; of horse, elk, ox, goat, sable, marten, badger, polecat, camel, and *bristles* of hog and boar. |
| | | | | | | | | Spiny | Mammals | *Quills* of porcupine; *bristles* of hedgehog; *spines* of aardvaark (orycteropus). |
| | | | | | Horny and Compact | 23 | Scaly-Scutose | | Reptiles | *Scutes* of reptiles in general (except Cheloniæ or turtles, and Loricata or crocodiles), having no visible use. |
| | | | | | | 24 | Hoofs | | Mammals | Pachyderms and Ruminants and Solidungula (solid-hoofed): rhinoceros, ox, bison, buffalo, sheep, goat, &c.; horse; the hoofs are made into boxes, buttons, glue, &c. |
| | | | | | | 25 | Horns and Antlers | | Mammals | *Horns* of ox, bison, buffalo, sheep, goat, chamois, rhinoceros. *Antlers* of red deer (stag), fallow deer, &c., elk, moose, wapiti. |
| | | | | Chitinous or sub-calcareous | | 26 | Crust | | Crustacea | Shell of crab, lobster, crawfish, crayfish made into fancy articles. |
| | | | Endo-Exoderm. | Strongly Nitrogenous; yield Ammonia | | 27 | Furs | Woolly | Mammals | *Woolly fur* of sheep, lamb, fœtal calf, moufflon, angora goat, Tibet goat, llama, alpaca, vicuna, guanaco. |
| | | | | | | | | Hairy | Mammals | *Hairy fur* of howling monkeys, lion, tiger, leopard, jaguar, puma, Canadian lynx, cat, dog, red fox, cross fox, Arctic fox, blue fox, black or silver fox, Cossack fox,—ermine, Russian sable, American sable, minx, polecat, pine marten, beech and stone martens, Tartar sable, pekan, skunk, American otter, sea otter. Black and brown bears, grizzly and white (or polar) bears, racoon, badger, glutton, or wolverine,—harp seal, bladder-nosed seal, common seal. Beaver, musquash or musk rat, coypu rat, squirrels (very many), chinchilla, hare, rabbit. American buffalo. |
| | | | | | | | | Downy | Birds | *Downy fur* of penguin, grebe, turkey, swan, puffin, &c., made into Victorines, boas, muffs, &c.; a few are natural furs, but most are artificial: in making these the Chinese are very clever. |

| | | | | | |
|---|---|---|---|---|---|
| INDUSTRIAL. | Various produce (secretions, &c.) not included in the above classification. | 28 | Calculose matter (see Ambergris, No. 7 above, and p. 312. | Molluscs | *Mother of pearl or nacre* of earshell (haliotis), topshell (turbo marmoratus), both Turbinidæ among Gasteropods, and used for buttons, inlaid and *papier mâché* work. *Pearl* found in all the six families of Asiphonida Lamellibranchiata, but chiefly in pearl mussel (avicula), river mussel (unio), common mussel (mytilus), common oyster (anodonta), thorny oyster (spondylus), wing shell (pinna), and in anomia (purple pearl), and arca (violet pearl). Pearls are found chiefly in the Indian Ocean and Persian Gulf (see Spurious Pearls, No. 14 above, and p. 313). |
| | | 29 | Tinctorial produce | A. Molluscs | *Inkbag* of cuttle fish (sepia officinalis), a cephalopod. Murex truncatus, a gasteropod, yields *Tyrian purple*. **B. Insects:** cochineal insect (coccus cacti), yields a scarlet dye. |
| | | 30 | Textile stuff | A. Molluscs | The bissus of wingshell (pinna) is made into gloves, socks, and caps in Sicily. **B. Insects:** the silkworm yields silk in Eastern and Southern Asia and Southern Europe. |
| | | 31 | Objectionable or Medicinal stuff | A. Fish | Cod liver oil. **B. Insects:** blisterfly (cantharis). **C. Annelida:** leech. |

*Prepared for the "Natural History of the Raw Materials of Commerce."*
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# GLOSSARY

OF THE

## PRINCIPAL TECHNICAL AND SCIENTIFIC TERMS.

*Acuminated.* Tapering to a point.

*Albumen.* Nutritive matter for the support of the embryo, deposited in many seeds; sometimes, as in the case of the grasses, constituting their chief bulk.

*Alluvium.* The mass of loam, clay, or other earthy materials accumulated by aqueous agencies, such as are found in valleys and plains.

*Alternate leaves* are situated at different heights on either side of the stem.

*Amorphous.* Applied to minerals having no determinate form, and without crystalline structure.

*Anhydrous.* Applied to minerals and chemical compounds, when water does not enter into their composition.

*Annulated.* Ringed.

*Antennæ.* A pair of jointed appendages proceeding from the heads of insects.

*Anther.* See *Stamen.*

*Anti-spasmodics.* Medicines which counteract spasms or convulsions.

*Areola.* A small shallow cavity.

*Argillaceous.* Of the nature of argil or clay.

*Arillus.* An expansion of the seed-stalk over the outer surface of the seed.

*Axillary.* Growing in the axilla of a leaf or bract; that is, in the angle formed by the leaf-stalk and stem.

*Basalt.* A volcanic rock, consisting of augite and felspar, of dark colour and high specific gravity.

*Bed.* An extended layer of mineral or rock.

*Bi-pinnate.* Twice pinnate.

*Bituminous.* Containing bitumen, an inflammable material of organic origin.

*Botryoidal.* Applied to minerals presenting an aggregation of small globes, from resemblance to the form of a bunch of grapes.

*Bract.* The abortive leaf at the base of a pedicle or flower-stalk.

*Branchial.* Appertaining to the branchiæ, or gills, the respiratory organs of those animals which breathe through the medium of water.

*Calyx.* The outermost of the floral envelopes.

*Capsule.* A dry hollow seed-vessel, dehiscing or opening by regular valves or seams.

*Carbonaceous.* Pertaining to coal.

*Cartilage.* Animal substance, commonly termed gristle.

*Caryopsis.* A fruit having a very thin indehiscent pericarp, closely adherent to the surface of the seed.

*Catkin.* A deciduous spike. Example: Willow.

*Cellular.* A tissue composed of membranaceous cells or cavities.

*Chlorophyle.* The green colouring matter of leaves.

*Cleavage.* Splitting into thin and even plates, which are not parallel to their planes of deposition—like ordinary roofing slates.

*Composite.* Compound.

*Contorted.* Twisted.

*Coriaceous.* Tough or leather-like.

*Corolla.* The part of the flower immediately within the calyx.

*Corymb.* A raceme with the lower pedicels of the flowers elongated, so as to bring all to the same height, thus forming a flat top. Example: Sweetwilliam.

*Corymbose.* Resembling a corymb.

*Cotyledon.* A seed lobe. Example: Scarlet bean, where the two cotyledons are large, forming the great bulk of the seed.

*Crystalline.* Consisting of crystals, or of an aggregation of imperfect crystals, not earthy in structure.

*Culm.* The stem of a grass.

*Cupellation.* The process of refining gold or silver by a cupel, a small crucible, made usually of phosphate of lime.

*Cuticle.* The outer skin of plants and animals.

*Cycloid scales.* Membranous, more or less circular in outline, and marked upon the surface with concentric lines.

*Deciduous.* Liable to fall; not permanent.

*Dentate.* Toothed.

*Denudation.* Geologically applied to the result of the operation of laying bare, and the consequent exposure of underlying rock.

*Detritus.* An accumulation of rocky fragments detached from solid rocks by mechanical forces.

*Diastase.* A substance contained in malt, capable of converting starch into sugar.

*Dichotomous.* Forked; regularly divided and subdivided into two equal branches.

*Digitate.* Resembling the fingers of the human hand.

*Diorite.* A plutonic rock, consisting of a felspar and hornblende. Greenstone is the best known variety.

*Dissepiments.* The partitions between the cells or cavities of an ovary or seed vessel. See interior of poppy capsule.

*Dolerite.* A rock closely allied to basalt.

*Dykes.* More or less rectilineal courses of igneous matter intruded into cracks or fissures of other rocks.

*Elongated.* Exceeding the average length.

*Endogens.* Inside-growing stems.

*Entire.* A leaf is said to be entire the margin of which is continuous and even, without serrature or notch.

*Escarpment.* The steep slope of a high ridge of land, or of any hill or rock.

*Exogens.* Outside-growing stems.

*Felspathic.* Consisting mainly of one of the felspar minerals.

*Femora.* The thigh-joint of the limb of an insect.

*Frond.* A combination of leaf and branch in one organ.

*Fruit.* This term is used in botany in its most enlarged meaning, as including the matured seed-vessel and its contents.

*Glabrous.* Smooth.

*Glacial drift.* The rocky materials distributed over the northern parts of Europe, America, and Asia during the Glacial Period.

*Globose.* Globular, spherical, round on all sides.

*Gneiss.* A metamorphic rock, consisting of quartz, felspar, and mica, arranged in alternate layers.

*Gossan.* The upper and disintegrated portion of a mineral vein.

*Granite* differs from gneiss in the minerals being confusedly grouped together.

*Graptolites.* A group of extinct animals, allied to the sea-mat. Restricted to the Silurian epoch.

*Grit.* A very hard compact sandstone.

*Herbaceous.* Not woody, of a tender consistence; usually destroyed by excess of heat or cold.

*Hilum.* The scar left on a seed by the separation of the seed-stalk; the black point of a bean.

*Hydro-carbons.* Compounds of hydrogen and carbon.

*Indehiscent.* Not opening at maturity.

*Indigenous.* Produced naturally in a country; not exotic.

*Inflorescence.* The arrangement of the flowers on the floral axis.

*Internodes.* The naked intervals of the stem between the nodes.

*Interstices.* Or interspaces.

*Involucre.* A collection of bracts or floral leaves, arranged in a closed spiral at the base of certain forms of inflorescence.

*Lanceolate.* Tapering gradually from near the base to the apex or summit.

*Larva.* An insect in the caterpillar or grub state.

*Lateral.* Springing from the side.

*Leaflet.* One of the divisions of a compound leaf.

*Legumes.* The pod of a bean or pea is a legume.

*Liber.* The inner or fibrous portion of the bark; so called because it was formerly used for writing on.

*Lobed.* Divided into lobes or segments; a term applied to leaves and petals.

*Lode.* A vein of metalliferous matter.

*Matrix.* The mineral or rocky substance in which metallic ores are found, or with which they are associated.

*Monœcious.* Having the stamens and pistils in separate flowers on the same plant.

*Native.* Applied to metals occuring in an uncombined state in the crust of the earth.

*Nodes.* The nodes of the stem are those points where the leaves arise, and so called because these parts of the stem are always more solid and compact than the other parts. All plants with hollow stems are solid here.

*Oblong.* Longer than broad.

*Obovate.* Inversely ovate, or with the broad end of the egg uppermost.

*Ovary.* The young seed-vessel or fruit.

*Ovate.* Egg-shaped in outline.

*Oviparous.* Producing eggs.

*Palmate.* Hand-shaped.

*Panicle.* A compound raceme, or a raceme having floral branches instead of single flowers attached to the floral axis or stem.

*Papilionaceous.* Butterfly-shaped. The pea-flower furnishes a good example.

*Pedicel.* One of the subdivisions of a compound peduncle; thus, the peduncle of a raceme is a compound peduncle, and its flowers are supported on partial peduncles or pedicels.

*Peduncle.* The stalk of a flower.

*Peltate.* Shield-shaped; the stalk occupying the centre and not the margin of the leaf.

*Perennial.* Living for more than two years, or for an indefinite period.

*Pericarp.* The seed-vessel.

*Petals.* The leaves of the corolla.

*Petiole.* The stalk of a leaf.

*Pinnate.* Having distinctly articulated leaflets in pairs on opposite sides of the axis of the leaf.

*Pinnatisect.* Pinnately cut or dissected.

*Pistil.* The floral leaf which receives the pollen, consisting usually of three parts called ovary, style, and stigma. This pistil is usually the central organ of the flower.

*Placental.* Pertaining to the placenta, the connecting substance between the parent and fœtus.

*Pollen.* The fertilising powder contained in the anthers.

*Porphyritic.* Applied to rocks exhibiting distinct crystals distributed through an otherwise compact or granular principal mass.

*Procumbent.* Lying on the ground.

*Pubescent.* Downy, or clothed with short hairs.

*Quadrangular.* Four-angled.

*Raceme.* Having single flowers on the floral axis or stem, supported on pedicels. Example : Cherry.

*Racemose.* Having the flowers in racemes.

*Recurved.* Curved backwards.

*Reverberatory.* A kind of furnace in which the object is exposed to an intense heat without coming in contact with the fuel.

*Rhizome.* An underground stem growing horizontally near the surface of the ground. Example : Calamus root.

*Rugose.* Wrinkled.

*Scutate.* Formed like a buckler or target.

*Sepals.* The leaves of the calyx.

*Septaria.* Flattened earthy concretions, the interiors of which are more or less radiately cleft, the cracks being filled by a crystalline mineral.

*Serpentine.* A rock ; the name suggested by the spots and streaks of red and green, approaching in its composition to the mineral so-called.

*Serrate.* Having teeth like a saw.

*Sessile.* A leaf or flower is sessile when the former is without a petiole, the lamina or blade only being developed and in immediate contact with the stem, and the latter without a peduncle or pedicle.

*Shale.* An argillaceous and fragile rock, breaking up unevenly into plates.

*Sheathing.* Leaves are sheathing when they embrace the stem with a membranaceous expansion towards the base of their petiole.

*Silicious.* Consisting mainly of quartz, which is chemically called silica.

*Sinuate.* A sinuate leaf is one with divisions open and rounded at the bottom. Example: Common oak.

*Spathaceous.* Resembling a spathe.

*Spathe.* A large sheathing kind of bract, forming a common calyx or involucre, open at one side.

*Spicules.* Silicious or calcareous spike-like bodies, found in the integuments of sponges and some other animals.

*Spike.* A form of inflorescence having the flowers sessile. Thus, if the flowers of a raceme were deprived of their pedicels, the inflorescence would become a spike. Example : Plantain.

*Spinose.* Thorny.

*Stamen.* The floral leaf which prepares the pollen, consisting of a

leaf-stalk called a filament, the blade or expanded portion of the leaf being contracted into an anther. The stamens are situated between the petals and the central leaf organs, called pistils.

*Stigma.* The top of the pistil. In the poppy the style is absent, the pistil consisting only of ovary and stigma.

*Striated.* Furrowed.

*Strike.* The course of a horizontal line on the surface of inclined beds.

*Sub.* This prefix to a scientific term is equivalent to somewhat, as Sub-cylindrical — somewhat cylindrical.

*Sub-cordate.* Somewhat heart-shaped.

*Sub-sessile.* Somewhat sessile, the petiole being nearly obsolete.

*Succulent.* Juicy; full of juice.

*Tentacula.* More or less filiform processes, simple or branched, from the body; usually surrounding the mouths of snails, cuttle-fishes, and some other animals.

*Terminal.* Situated towards the end or summit of the axis of growth.

*Tissue.* A number of cells united is called a tissue.

*Trilobites.* An extinct order of crustacea that lived from the Cambrian to the Carboniferous Limestone periods inclusive.

*Tuberculous.* Having little swellings or pimples.

*Tuberous.* Consisting of tubers, or solid fleshy bulbs. Example: Potato.

*Unconformability.* Applied to strata without parallelism; such as when series of beds, having a considerable inclination, are overlain by other beds more or less horizontal.

*Veins.* Cracks or fissures of variable magnitude, filled with mineral matters, either originating in and confined to the rock in which they occur, or connected with extraneous masses; filled partly by segregation, partly by sublimation, and partly by decomposition of volatile substances which have permeated the earth's crust through such channels.

*Viscid.* Clammy; covered with a sticky or adhesive moisture.

*Whorl, or Verticil.* Flowers, leaves, or other organs arranged around the stem in a horizontal ring.

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